



GEOLOGICAL SURVEY OF CANADA

OPEN FILE 4166

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A. Plouffe, V.M. Levson and D.J. Mate

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TILL GEOCHEMISTRY OF THE NECHAKO RIVER MAP AREA (NTS 93F), CENTRAL BRITISH COLUMBIA

A. Plouffe, V.M. Levson, and D.J. Mate

Abstract

Following the Canada-British Columbia Agreement on Mineral Development (1991-1995) and the Nechako NATMAP Project (1995-2000), the British Columbia Geological Survey Branch and the Geological Survey of Canada have completed a series of regional and reconnaissance till geochemistry surveys within the Nechako River map area (NTS 93F). This report presents a compilation of the geochemical analyses conducted on the clay- (<0.002 mm) and silt and clay-sized (<0.063 mm or -230 mesh) fractions of till. Results for gold and pathfinder elements (arsenic, barium, mercury, antimony), base metals (copper, lead, zinc), molybdenum, and three lithophile elements (aluminium, magnesium, sodium) are presented on colored geochemical maps and discussed in the text. Interpretation of the till geochemistry data takes into account, bedrock geology, known mineral occurrences, ice-flow history, analytical and digestion methods, and grain size of the analyte. Several sites with anomalous metal concentrations in till and not located near known mineralization are indicated. These reveal the high potential for new mineral discoveries within the Nechako River map area.

Résumé

Dans le cadre de l'Entente Canada-Colombie-Britannique sur l'exploitation minérale (1991-1995) et du projet CARTNAT Nechako (1995-2000), la Commission géologique de la Colombie-Britannique et la Commission géologique du Canada ont complété une série de levées régionales et de reconnaissance de la géochimie du till dans la région couverte par le feuillet topographique de la rivière Nechako (Système topographique national 93F). Ce rapport contient une compilation des analyses géochimiques effectuées sur la fraction de l'argile (<0.002 mm) et du silt et de l'argile (<0.063 mm or -230 mesh) du till. Les résultats d'analyse pour l'or et ses éléments traceurs (arsenic, baryum, mercure, antimoine), les métaux de base (cuivre, plomb, zinc), le molybdène et trois éléments lithophiles (aluminium, magnésium, sodium) sont présentés sur des cartes géochimiques en couleur et discutés dans le texte. L'interprétation des données géochimiques du till prend en considération la géologie de la roche en place, les zones minéralisées connues, la direction des écoulements glaciaires, les méthodes pour la mise en solution des échantillons à analyser, les méthodes analytiques, et la fraction granulométrique de la matière à analyser. On dénombre plusieurs sites qui ne sont pas localisés près de zones minéralisées connues et qui possèdent des concentrations anormales de métaux dans le till. Ces derniers illustrent le haut potentiel de découvrir de nouvelles zones minéralisées à l'intérieur de la région couverte par le feuillet topographique de la rivière Nechako.

Introduction

As part of the Canada-British Columbia Agreement on Mineral Development (1990-1995) and the Nechako NATMAP Project (1995-2000), a series of regional and reconnaissance till geochemistry surveys were conducted within the Nechako River map area (National Topographic System (NTS) 93F) by the British Columbia Geological Survey (BCGS) and the Geological Survey of Canada (GSC) (Fig. 1). The primary objective of these surveys is to provide baseline information on metal distribution in till as an aid for mineral exploration in a region where the thick glacial sediment cover and lack of bedrock outcrop represents a major hindrance to conventional mineral exploration. [The methodology and successful case studies related to drift prospecting (sampling of glacial sediments for mineral exploration) in the Canadian Cordillera is outlined in Bobrowsky et al. (1995)]. As a secondary objective of this report, regional till geochemistry can be used in environmental assessments to demonstrate the variability of background metal levels in the surficial environment over various bedrock types. Such information is particularly useful in the case of potentially toxic metals such as mercury and arsenic that occur naturally in bedrock and sediments and can be mobilized in the environment because of anthropogenic activities such as logging and flooding resulting from the impoundment of hydroelectric reservoir. These elements could become available to biota following their mobilization in the environment.

Three regional till geochemistry open files and one report on an orientation survey conducted on three mineral properties have previously been published for the Nechako River map area (Levson et al., 1994; O'Brien et al., 1997; Weary et al., 1997; Plouffe and Williams, 1998). In addition, two till geochemistry open files for the 93F/2, F/5, and F/12 map areas are presently being prepared by the British Columbia Geological Survey Branch (Mate and Levson, in press). The objective of this report is to compile all till geochemistry data (published and unpublished) available for the Nechako River map area which will allow a better interpretation of regional variations of elemental concentrations in till.

Other reports on regional lake sediment geochemistry (Cook and Jackaman, 1994) and biogeochemistry (Dunn and Hastings, 1998) have been published for parts of the

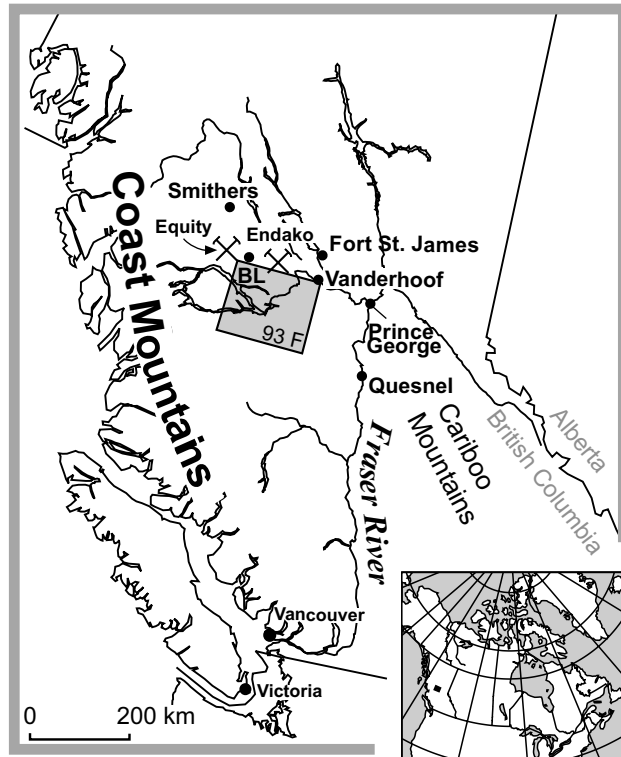


Figure 1. Location of Nechako River map area (NTS 93F) in British Columbia; (BL - Burns Lake).

Nechako River map area.

Description of the study area

The Nechako River map area lies in the central part of British Columbia and extends from latitude 53° to 54° and from longitude 124° to 126°. The map area is part of the Nechako Plateau physiographic region (Holland, 1976) which is a low relief region characterized by rolling topography with an average elevation of about 1060 m above sea level (asl) (Fig. 2). The Nechako Plateau includes the Fawnie and Nechako ranges which are more rugged than the surrounding region with rounded mountain summits and subdued cirques and arêtes that reaches elevations greater than 1600 m asl. The northeastern sector of the map area is part of the Fraser Basin physiographic region which is similar to the Nechako Plateau but is incised by tributaries of the Fraser River. The region southeast of West Road (Blackwater) River is part of the Fraser Plateau physiographic region.

Most of the larger rivers in the map area, including the Nechako, Chilako, Euchiniko and West Road (Blackwater) rivers, drain easterly into the Fraser River. The Nechako River drainage was diverted following the construction of Kenney Dam in 1952. The Nechako Reservoir, the impoundment behind Kenney Dam, drains in a tunnel through the Coast Mountains to the Pacific Ocean; its level is controlled at the Skins Lake Spillway.

The study area can be accessed by a network of forestry roads that originate from the towns of Vanderhoof, Fraser Lake, Fort Fraser and Burns Lake located along Highway 16, a few kilometres north of the map boundary. South of the town of Burns Lake, the study area can be accessed via a ferry across François Lake and a private barge across Ootsa Lake.

Bedrock geology and mineralization

A simplified bedrock geology map and legend compiled from Anderson et al. (in press) is depicted on Sheets 1 and 2 (in pocket). The geochemical maps provided with this report are underlain by the simplified bedrock geology to facilitate data interpretation. It should

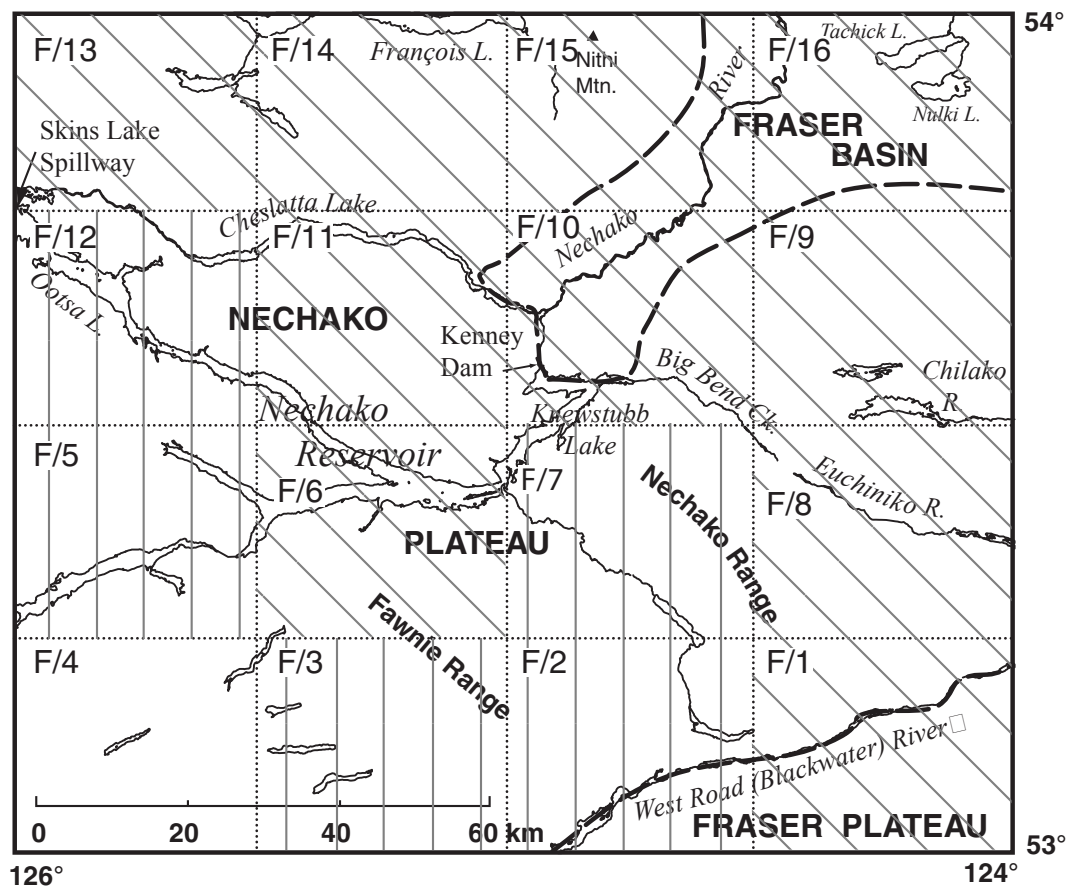


Figure 2. Physiography of the Nechako River map area (NTS 93F). Vertical pattern indicates BCGS project areas and oblique patterns GSC project areas. The region is subdivided per 1:50 000 scale NTS map areas.

be noted that the bedrock geology compilation for the Nechako River map area was still under progress at the time of publication of this open file so that contacts between lithological units might be inconsistent across certain map boundaries.

The area is underlain by volcanic rocks with lesser sedimentary rocks dominantly of Jurassic age. These rocks are covered in large parts by Eocene and Miocene basalt, andesite, and rhyolite with associated volcanoclastic rocks. Jurassic rocks predominate in a region which extends from northwest of Ootsa Lake, to the area south and southeast of the Nechako Reservoir. Intrusive rocks in the region include Jurassic, Cretaceous, and Eocene granite to diorite plutons. Papers, maps and reports on the bedrock geology of the Nechako map area were presented by Tipper (1963), Anderson et al. (1997), Diakow and Levson (1997), Wetherup (1997), Anderson and Snyder (1998), Anderson et al. (1998, 2000a, 2000b), Whalen et al. (1998) and Pint et al. (2000).

A moderate potential for mineralization exists within the study area as suggested by the presence of 68 recorded mineral occurrences (Bailey et al., 1995) (Map 1, Sheet 1 in pocket and Table 1), the presence of Endako Mine (porphyry molybdenum deposit) 5 km to the north and the past-producing Equity Mine (subvolcanic copper-silver-gold deposit) 30 km northwest of the study area (Fig. 1). The dominant styles of bedrock mineralization present in the study area include: 1) epithermal gold-silver occurrences hosted in Eocene (e.g. Trout, Wolf, Uduk Lake, and Loon showings) and Jurassic (e.g. Fawn and Tsacha showings) felsic volcanic rocks (Map 1, Sheet 1 in pocket), 2) molybdenum and copper porphyry mineralization associated with Tertiary and possibly older intrusions (e.g. CH, April, and Chu showings), and 3) molybdenum vein mineralization with localized uranium mineralization dominantly focused in the vicinity of Nithi Mountain (Fig. 2) (e.g. Nithi Mountain, Nithi, Jen 4, Jen 10, and Tan showings). Description of the mineral showings and prospects of the region can be found in Diakow and Webster (1994), Schroeter and Lane (1994), Lane and Schroeter (1995, 1997), L'Heureux and Anderson (1997), Anderson and Snyder (1998), Anderson et al. (1998, 2000a), and on the British Columbia Geological Survey Branch web site at: www.em.gov.bc.ca/mining/Geolsurv/MapPlace/.

Table 1. List of mineral occurrences and commodities of the study area.

Mineral occurrences	Commodities	Mineral occurrences	Commodities
APRIL	Au, Ag, Zn	L	Cu, Mo
BEN	Au, Ag, Pb, Zn, Cu,	L NORTH	Cu
BLACKWATER-DAVIDSON	Au, Ag, Zn, Pb, Cu	LAIDMAN	Au, Ag, Pb, Zn
BOSS	Cu, Ag, Au, Pb, Zn	LOON	Au, Ag
BUCK	Ag, Zn, Pb, Au, Cu,	MOLLY 8	Mo
BULL 4	Au, Ag, Pb, Zn	MOLLY 9	Mo
C	Mo, Cu	MOUNT GREER	Coal
CABIN	Ag, Pb, Zn, Cu,	NAT	Cu, Mo
CALEDONIA	Mo, Cu	NED	Cu, Mo
CAP	Cu, Mo	NITHI	Mo
CAPOOSE	Au, Ag, Zn, Pb, Cu	NITHI MOUNTAIN	Mo, U
CAPOOSE PORPHYRY	Cu, Mo	NORTHWEST	Mo
CHELASLIE ARM	Mo	OOTSA 1	Fluorite
CHESLATTA LAKE	Volcanic glass – perlite	OWL	Mo, Cu
CHRIS	Mo	PARK 14	Mo
CHU	Mo, Cu	PAW	Cu, Mo
ENCO 3 FR.	Mo	RHUB	Cu, Au, Ag
EXO	W, Cu, Mo, Ag, Zn	STUBB	Au
FAWN	Au, Ag, Zn	SWAN 1	Au, Ag, Cu
FAWN 5	Fe, Cu, Au	T	Mo
FINGER LAKE	Fe	TAM	Au, Ag, Zn, Pb
GEL	Mo, Cu	TAN	Mo
GODOT	Cu, Mo	TAT	Cu
GUSTY	Au, Ag, Mo,	TET	Cu, Mo
H	Cu, Mo	TETACHUCK LAKE	Zn, Ag, Au
HENSON HILLS	Volcanic glass – perlite	TROUT	Au, Ag
HIDDEN	Ag, Pb, Au	TSACHA	Au, Ag, Cu
HOLY CROSS	Au, Ag, Cu	TSACHA LAKE	Diatomite, pumice
JEN - BEAVER	Mo	UDUK LAKE	Au
JEN 10	Mo	UNCHA LAKE	Volcanic glass – perlite
JEN 4	Mo	WOLF	Au, Ag
JEN 7	Mo	WT	Cu, Mo
KLUSKOIL LAKE	Limestone	YELLOW MOOSE	Au
KO	Cu, Zn, Mo		

Surficial geology

A number of surficial geology maps were published for the Nechako River map area or are currently in progress (Levson and Giles, 1994; Giles and Levson, 1995; Weary et al., 1995; Plouffe, 1998b; Mate and Levson, 2000; Plouffe and Mate, 2001; Plouffe and Levson, in press-a, in press-b). Recent papers on the Quaternary stratigraphy of the Nechako River map area were published by Plouffe and Levson (2001) and Mate and Levson (2001).

Till of the Late Wisconsinan Fraser Glaciation is the most abundant surficial deposit in the region. It consists of a poorly sorted diamicton that contains clasts of all sizes in a matrix of sand, silt, and clay (Fig. 3). The amount and size range of the clasts present in till and the texture of the matrix varies throughout the region but on average the matrix is composed of 54% sand, 43% silt and 3% clay as determined from grain size analyses of 314 till samples. The till averages 2 to 5 metres in thickness over most of the Nechako Plateau and Fraser Basin but is thin (1 metre and less) on major hills and may locally be greater than 10 m thick.

Variable thicknesses of glaciofluvial sand and gravel deposits are present in the larger valleys and near the mouths of large meltwater channels. Important accumulations of glaciolacustrine sediments, locally greater than 10 metres thick, are present in the Knewstubb Lake region, Nechako River valley, and in a partly buried valley which extends from François Lake to the Tachik and Nulki lakes region (Plouffe, 1991). These deposits accumulated in glacial lakes which developed at the end of the last glaciation following damming of the drainage by ice and sediments. Only in the corridor that extends from François Lake to the Tachick and Nulki lakes region was the glaciolacustrine sediment cover consistent and thick enough to hinder till sampling.

Holocene sediments include colluvium, alluvium and organic deposits. Colluvium (sediments deposited by mass wasting processes) are localized and dominantly found on steep slopes. All valleys contain certain accumulations of modern stream sediments (alluvium). The greatest accumulations of alluvium were observed in the Nechako River valley. Organic deposits (peat and muck) are omnipresent within the study area. They

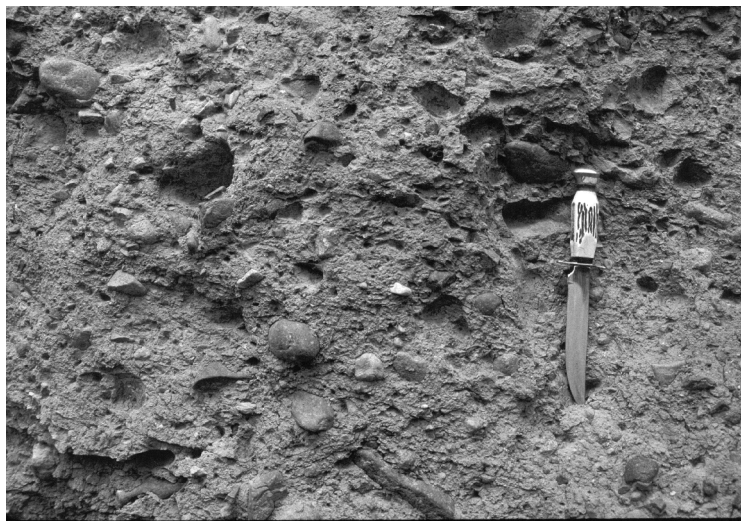


Figure 3. Close view of till of the Fraser Glaciation. The knife is 25 cm long.

generally occur on poorly drained substrates.

Ice-flow history

A generalized ice-flow map is provided in pocket (Map 2, Sheet 1). The regional ice-flow patterns were constructed from the surficial geology maps of the study area (Levson and Giles, 1994; Giles and Levson, 1995; Weary et al., 1995; Plouffe, 1998b; Plouffe and Mate, 2001; Plouffe and Levson, in press-a, in press-b).

A proper understanding of the ice-flow history of a region is necessary for the interpretation of the till composition. The Nechako River map area was last glaciated during the Late Wisconsinan Fraser Glaciation. At the onset of glaciation, valley glaciers formed locally within the Fawnie and Nechako ranges. However, the dominant source of ice was located in the high regions of the Coast and Cariboo mountains, to the west and southeast of the study area, respectively. Following the coalescence of valley glaciers in the Coast Mountains, thin ice tongues first advanced easterly into the Interior Plateau parallel to the major valleys, but as ice built up, glaciers covered the highest mountains of the area and flowed in a general northeastward direction. The regional northeastward ice flow resulted from the coalescence of easterly flowing Coast Mountains' glaciers with northward flowing glaciers derived from the Cariboo Mountains. At glacial maximum, the ice divide located over the Coast Mountains migrated easterly as far as the western part of the study area (Levson et al., 1999; Stumpf et al., 2000; Ferbey and Levson, 2001). As a result, the area over which the ice divide migrated experienced a shift from easterly to westerly ice flow. Consequently, westward ice flow probably only affected the northwestern sector of the study area during the last glaciation (Levson et al., 1999; Mate and Levson, 2000; Plouffe and Mate, 2001) (Map 2, Sheet 1 in pocket). Evidence for regional and local westward glacial transport was identified west and northwest of the study area in the region most affected by the ice-flow reversal (Ney et al., 1972; Sutherland Brown, 1975; Stumpf et al., 2000) but, it has not been documented within the Nechako River map area.

In summary, glacial transport over most of the region was to the east to northeast as revealed by regional ice-flow indicators. The northwestern sector of the study area was

also subjected to a general westward flow event at the glacial maximum, but its effect on glacial transport remains to be evaluated.

Methods

Field methods

Till samples were collected in hand-dug pits, road side cuts and natural bluffs (Fig. 4, 5). The abundance of fresh till exposures along forestry roads greatly facilitated the sampling program. Samples were collected below the oxidized horizon of soil profiles which corresponds to a minimum depth of 0.8 m. Where thick till is exposed, samples were collected at different depths to assess the vertical variability in till composition. Access to sampling sites was dominantly by truck following an extensive network of forestry roads, but also by foot traverses and by helicopter to some remote sites.

Because the nature and objectives of the projects undertaken by the BCGS and the GSC were different, till sample density varies throughout the region. In the regions covered by the BCGS projects (93F/2, F/3, F/5, F/7 and F/12) the average sample spacing is approximately 1 km. The sample spacing averages 5 km in the GSC project areas (93F/1, F/6, F/8, F/9, F/10, F/11, F/13, F/14, F/15 and F/16). However, sample spacing is much greater in areas with poor road or trail access (e.g. the vast majority of F/6 map sheet). No samples were collected on NTS sheet 93 F/4 because of the poor access and because a large part of the map area lies within the Tweedsmuir Provincial Park.

Laboratory methods

Geochemical analyses were conducted on two different grain size fractions: the clay-sized (<0.002 mm, <2 μ m) and the silt and clay-sized fractions (<0.063 mm, <63 μ m, - 230 mesh). The silt and clay-sized samples were separated by dry sieving and the clay-sized samples were prepared using a centrifuge following procedures outlined in Lindsay and Shilts (1995). Clay separations were done with the use of a dispersant (sodium hexametaphosphate) which limits clay particle flocculation but contaminates the clay-sized samples with phosphate.



Figure 4. Typical till exposure along forestry road.

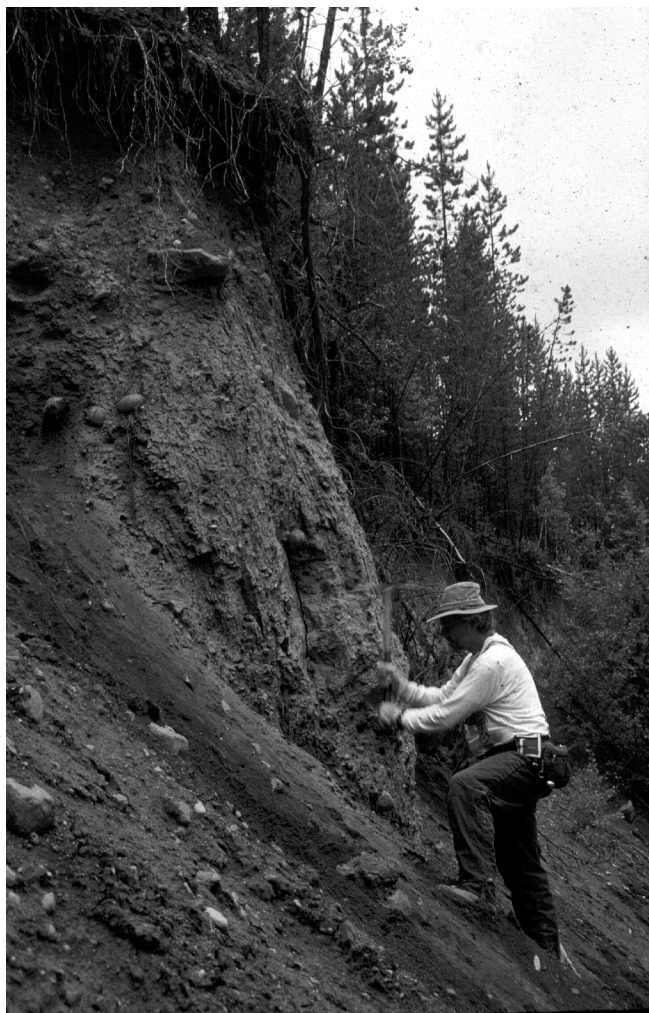


Figure 5. Till sampling on a natural exposure
20 km south of Tatuk Lake.

The clay-sized and the silt and clay-sized fractions were analyzed by inductively coupled plasma - atomic emission spectrometry (ICP-AES) after an aqua regia digestion for a suite of elements (Table 2 and 3). Approximately 1 g of material was used for ICP-AES analyses. Only the clay-sized fractions were analyzed for Hg by cold-vapor atomic absorption (CV-AA), following an aqua-regia digestion. CV-AA was selected for Hg analyses because of its lower detection limit compared to ICP-AES. The clay-sized fractions were analyzed at Chemex Labs Ltd., and the silt and clay-sized fractions were analyzed at Acme Analytical Laboratories Ltd. (BCGS projects) and Chemex Labs Ltd. (GSC projects). The silt and clay-sized fractions (30 g samples) from the GSC and the BCGS were analyzed for 35 elements by instrumental neutron activation (INA) at Activation Laboratories Ltd. (Table 4).

Table 2. List of elements and detection limits (Det. lim.) for ICP-AES analyses at Chemex Labs Ltd. Hg was analyzed by CV-AA.

Element	Det. lim.	Element	Det. lim.	Element	Det. lim.
Ag	0.2 ppm	Fe	0.01 %	Pb	2 ppm
Al	0.01 %	Ga	10 ppm	Sb	2 ppm
As	2 ppm	Hg	10 ppb	Sc	1 ppm
Ba	10 ppm	K	0.01 %	Sr	1 ppm
Be	0.5 ppm	La	10 ppm	Ti	0.01 %
Bi	2 ppm	Mg	0.01 %	Tl	10 ppm
Ca	0.01 %	Mn	5 ppm	U	10 ppm
Cd	0.5 ppm	Mo	1 ppm	V	1 ppm
Co	1 ppm	Na	0.01 %	W	10 ppm
Cr	1 ppm	Ni	1 ppm	Zn	2 ppm
Cu	1 ppm	P	10 ppm		

Table 3. List of elements and detection limits (Det. lim.) for ICP-AES analyses at Acme Laboratories Ltd.

Element	Det. lim.	Element	Det. lim.	Element	Det. lim.
Ag	0.1 ppm	Cr	1 ppm	Ni	1 ppm
Al	0.01 %	Cu	1 ppm	P	0.001 %
B	2 ppm	Fe	0.01 %	Pb	2 ppm
Ba	2 ppm	K	0.01 %	Sr	1 ppm
Bi	2 ppm	Mg	0.01 %	Ti	0.01 %
Ca	0.01 %	Mn	1 ppm	V	2 ppm
Cd	0.2 ppm	Mo	1 ppm	Zn	1 ppm
Co	1 ppm	Na	0.01 %		

Geochemical analyses were not conducted on the clay-sized fraction of the samples collected prior to 1996 by the BCGS which correspond to the samples located on NTS map sheets 93F/2, 3, and 7. Therefore, analytical results of the clay-sized fraction cover a smaller geographic area than the silt and clay-sized fraction.

Data quality and control

Blank duplicates and standard samples were sent with every sample batch to the analytical laboratories to evaluate analytical precision and accuracy. Two types of duplicate samples were used: field duplicates (two samples from the same till sample site) and laboratory duplicates (sample split taken after completion of the grain size separation).

Table 4. List of elements and detection limits (Det. lim.) for INAA analyses at Activation Laboratories Ltd.

Element	Det. lim.	Element	Det. lim.	Element	Det. lim.
Au	2 ppb	Ir	5 ppm	U	0.5 ppm
Ag	5 ppm	Mo	1 ppm	W	1 ppm
As	0.5 ppm	Na	0.01 %	Zn	50 ppm
Ba	50 ppm	Ni	20 ppm	La	0.5 ppm
Br	0.5 ppm	Rb	15 ppm	Ce	3 ppm
Ca	1 %	Sb	0.1 ppm	Nd	5 ppm
Co	1 ppm	Sc	0.1 ppm	Sm	0.1 ppm
Cr	5 ppm	Se	3 ppm	Eu	0.2 ppm
Cs	1 ppm	Sn	0.01 %	Tb	0.5 ppm
Fe	0.01 %	Sr	0.05 %	Yb	0.2 ppm
Hf	1 ppm	Ta	0.5 ppm	Lu	0.05 ppm
Hg	1 ppm	Th	0.2 ppm		

Correlation plots depicting results of duplicate analyses and analytical precision (“p” on correlation plots) calculated at the 95th confidence level, following the method outlined by Garrett (1969) (see formula below) are reported in Appendix 1, for Chemex Labs Ltd. and Activation Laboratories Ltd. Results of duplicate analyses performed at Acme Laboratories Ltd. are presented in Levson et al. (1994) and Weary et al. (1997).

Analytical results of the GSC in-house standard are given in Appendix 2.

$$\text{Analytical precision} = \frac{1.98 \cdot \sigma_A}{X}$$

σ_A : standard deviation of duplicate samples
 X : mean concentration of the duplicate samples

Table 5. Analytical precisions. Values represent \pm %.

Size fractions	<0.002 mm	<0.063 mm	<0.063 mm	Size fractions	<0.002 mm	<0.063 mm	<0.063 mm
Analytical methods	ICP-AES	ICP-AES	INAA	Analytical methods	ICP-AES	ICP-AES	INAA
Elements				Elements			
Al	10	18	--	Mn	11	14	--
As	40	73	21	Mo	55	--	167
Au	--	--	170	Na	26	28	20
Ba	12	16	25	Nd	--	--	36
Be	29	--	--	Ni	11	12	--
Ca	13	26	62	P	33	11	--
Cd	44	--	--	Pb	11	42	--
Ce	--	--	23	Rb	--	--	34
Co	12	17	30	Sb	150	--	25
Cr	13	22	26	Sc	11	20	30
Cs	--	--	35	Sm	--	--	25
Cu	10	11	--	Sr	13	14	--
Eu	--	--	28	Ta	--	--	121
Fe	8	10	26	Tb	--	--	68
Hf	--	--	25	Th	--	--	21
Hg*	25	--	--	Ti	22	18	--
K	15	25	--	U	--	--	42
La	10	26	18	V	12	12	--
Lu	--	--	23	Yb	--	--	25
Mg	12	10	--	Zn	8	18	50

*CV-AAS

The analytical precision of both methods (ICP-AES and INA) was evaluated as satisfactory for elements with concentrations well above detection limit (Appendix 1 and Table 5). However, the precision is poor for elements with reported concentrations approaching detection limit (e.g. Mo by ICP-AES and INAA, and Ca, Ta, and Tb by

INAA). In the case of gold, the poor analytical precision is attributed to the heterogeneous distribution of this metal in till (nugget effect) combined with concentrations that are close to the detection limit. The analytical precision of ICP-AES analyses is generally better for the clay-sized than the silt and clay-sized fraction because of the higher concentrations and more homogeneous elemental distribution in the clay-sized than the silt and clay-sized material. The analytical accuracy was judged satisfactory based on the analyses of the GSC in-house standard TCA-8010. With few exceptions, there was little variation in the analytical accuracy for the 1996 to 1999 time period. Furthermore, the geochemical results obtained for standard TCA-8010 are generally close to the mean concentrations calculated from 70 recent analyses of the same standard (Appendix 2).

Comparison of commercial analytical laboratories

As indicated in the section of Laboratory methods, the silt and clay-sized fraction was analyzed in two different commercial laboratories: BCGS samples were analyzed at Acme Laboratories Ltd. and GSC samples at Chemex Laboratories Ltd. To assess the comparability of the geochemical results provided by both laboratories, a set of fifty samples of the silt and clay-sized fraction originally analyzed at Acme Laboratories Ltd. was resubmitted to Chemex Labs Ltd. Such evaluation was found necessary to eliminate variability related to the specificity of the analytical procedures of each laboratory, so that analytical results of the silt and clay-sized fraction from both laboratories could be plotted on the same map.

A Student's t-test was run to verify if the differences between analytical results from both laboratories are significant at the 95th confidence level (see file *T test 2 labs.xls* on CD-ROM). Most elements (Al, As, Ba, Co, Cu, Fe, K, Mn, Mg, Mo, Na, Ni, P, Pb, Sr, and V) returned a t value greater than the 5% probability ($t > 2$ with a degree of freedom = 49) which indicated that there was a statistically significant difference between the analytical results provided by both laboratories. Consequently, a correction was applied to those elements using the best fit linear regression before plotting the geochemical maps presented in pocket (Appendix 3). For most elements, the best fit linear regression was

calculated with a large number of samples spanning the full range of concentrations. However, for As, Na, Mo, and Pb the linear regression is partly controlled by a few isolated high concentrations. Corrected values were rounded to respect the number of significant digits. Samples that yielded concentrations below the detection limit were not corrected and were left with a concentration equivalent to half the detection limit. Because a greater proportion of the silt and clay-sized samples were analyzed at Acme Analytical Laboratories Ltd. corrections were applied to the analytical results from Chemex Labs Ltd. Nevertheless, this open file contains both the corrected (file: 63um_ICP_comb) and uncorrected results (files : 63um_ICP_GSC and 63um_ICP_BCGS) (Table 6). Obviously, no corrections were necessary for the INA analyses on the silt and clay-sized fraction and the ICP-AES analyses on the clay-sized fraction because all those analyses were conducted in the same commercial laboratories. All following discussion on the geochemical results relate to the corrected results.

Geochemical results

All geochemical results are provided in digital format on the CD-ROM included with this report. Table 6 summarizes the content of the geochemical files. The files are available in text (tab delimited, .txt) and Microsoft Excel version 5.0 (.xls) formats. In addition to the geochemical data, these files contain information divided into columns as described in Table 7. The second and third lines of the geochemical files contain the units and the analytical detection limits, respectively.

A strict convention was followed in the geochemical files so that geochemical results can be imported and plotted using a geographic information system (GIS). A value of -9 indicates that there is no data for that particular entry. Samples that yielded a concentration below detection limit were given the value of half the detection limit.

Interpretation of geochemical results

Geochemical maps are presented on two sheets in pocket. Maps were prepared for a selected number of elements which are discussed below. Each map contains approximately the 50th, 75th, 90th, 95th, 99th and 100th percentiles of the elemental

concentrations which are depicted by color categories. Some points might be hidden on the maps because of the high sample density in certain regions or because two samples collected at the same site at different stratigraphic level (see Field methods) are plotted one on top of each other.

Table 6. Geochemical files included on the CD-ROM.

File Name	Content
2labs_63um_ICP	Results of ICP-AES analyses on the silt and clay-sized fraction (<0.063 mm) of samples analyzed at both Chemex Labs Ltd. and Acme Analytical Laboratories Ltd.
2um_ICP_all	Results of ICP-AES analyses on the clay-sized fraction (<0.002 mm) of all samples
63um_ICP_all	Results of ICP-AES analyses on the silt and clay-sized fraction (<0.063 mm) of all samples; corrected results (see Comparison of analytical laboratories above)
63um_ICP_BCGS	Results of ICP-AES analyses on the silt and clay-sized fraction (<0.063 mm) of the samples from the BCGS; results not corrected (see Comparison of analytical laboratories above)
63um_ICP_GSC	Results of ICP-AES analyses on the silt and clay-sized fraction (<0.063 mm) of the samples from the GSC; results not corrected (see Comparison of analytical laboratories above)
63um_INA_all	Results of INA analyses on the silt and clay-sized fraction (<0.063 mm) of all samples
Dup_2um_ICP	Results of duplicate sample analyses by ICP-AES on the clay-sized fraction
Dup_63um_ICP	Results of duplicate sample analyses by ICP-AES on the silt and clay-sized fraction
Dup_63um_INA	Results of duplicate sample analyses by INA analyses on the silt and clay-sized fraction
Std_2um_ICP	Results of ICP-AES analyses of standard TCA-8010 analyzed with clay-sized fraction samples
Std_63um_ICP	Results of ICP-AES analyses of standard TCA-8010 analyzed with silt and clay-sized fraction samples
Std_63um_INAA	Results of INA analyses of standard TCA-8010 analyzed with silt and clay-sized fraction samples
T test 2 labs.xls	Student's t-test which compares analytical results from Chemex Labs Ltd. and Acme Analytical Laboratories Ltd. This file contains two sheets and is only available in Microsoft Excel format (v. 5).

Table 7. Data structure of the geochemical files

Column heading	Description
Sample ID	Unique sample identifier
Org	Organization that conducted the sampling survey: GSC or BCGS
Laboratory	Name of the commercial analytical laboratory
Anal method	Analytical method
Size fraction	Size fraction in mm on which geochemical analyses were conducted
Depth	Sample depth from the surface measured in metres
Datum	All coordinates were calculated using the North American Datum 1927 (NAD 27)
Zone	UTM zone; all sample sites are located in zone 10
Easting	Sample site location; UTM easting in metres
Northing	Sample site location; UTM northing in metres
Longitude	Sample site location; longitude in decimal degrees
Latitude	Sample site location; latitude in decimal degrees

Geochemical patterns of regional significance and geochemical anomalies are briefly discussed in this section. The discussion is centered on elements of potential economic or environmental significance and takes into account the bedrock geology, known mineral occurrences, ice-flow history, analytical and digestion methods, and grain size of the analyte. Analytical results of three lithophile elements (Al, Mg, and Na) are discussed to demonstrate the regional variation in till composition and the potential applicability of lithophile element concentrations to mineral exploration. The mean and median elemental concentrations of all elements discussed are presented in Table 8.

Gold

Gold concentrations were only measured in the silt and clay-sized fraction by INA (Map 3, Sheet 1 in pocket). Gold concentrations are generally low with 46 % of the samples yielding a concentration below the detection limit of 2 ppb. Levson and Giles (1997) have identified a gold dispersal train in till which extends 5 km to the northeast (down- ice) from the Wolf gold-silver showing. The dispersal train is characterized by gold concentrations above 15 ppb in the silt and clay-sized fraction. Similarly, a 6 km long gold dispersal train occurs near the CH showing and is defined by gold concentrations

Table 8. Mean and median metal concentrations. Values are in ppm unless indicated.

Size fractions		Clay		Silt plus clay		
Analytical method	ICP-AES		ICP-AES		INA	
Element	Mean	Median	Mean	Median	Mean	Median
Au	---	---	---	---	4 ppb	2 ppb
As	14	12	5	5	12	10
Ba	219	210	142	135	762	740
Hg*	115 ppb	90 ppb	---	---	---	---
Sb	---	---	---	---	1.8	1.5
Cu	59	53	28	25	---	---
Pb	13	12	10	9	---	---
Zn	128	126	68	64	---	---
Mo	1	1	1	1	---	---
Al	3.4%	3.3%	1.48%	1.43%	---	---
Mg	1.2%	1.1%	0.49%	0.44%	---	---
Na	0.58%	0.62%	0.04%	0.04%	2.18%	2.18%

*CV-AAS analyses for Hg

greater than 8 ppb in the silt and clay-sized fraction (O'Brien et al., 1997). Both of these dispersal trains are not visible on the regional till geochemistry map (Map 3, Sheet 1 in pocket) because the results of the detailed sampling conducted by Levson and Giles (1997) and O'Brien et al. (1997) are not included in this report. From these orientation surveys, it should be expected that any other gold dispersal trains in the study area will be short, most likely on the order of 5 km, and that the threshold gold concentration for the region likely varies from 8 to 15 ppb. Because of the short length of known gold dispersal trains, it is unlikely that two or more adjacent till samples will fall within the limits of a dispersal train and depict anomalous gold concentrations. Therefore, a single isolated high gold concentration (>8 ppb) in till could be significant as it could be the sole indicator of a gold dispersal train. On the other hand, the heterogeneous distribution of gold in till can result in false anomalies (nugget effect). Consequently, no extensive follow-up survey should be undertaken in a vicinity of an anomaly until the anomaly is reproduced. This should be done by resampling till in the region of interest and conducting geochemical analyses on the same grain size fraction.

Gold concentrations in till near bedrock mineralization are in most cases much less than in the mineralized bedrock because of the mixing of mineralized and unmineralized bedrock lithologies during glacial erosion, transport, and deposition. Consequently, the significance of a gold concentration in till should be evaluated by comparison with regional background concentrations in till and not with concentrations in mineralized bedrock.

Several high gold concentrations in till not related to known mineralization have been identified within the Nechako River map area and were reported by Levson et al. (1994), Weary et al. (1997), Plouffe and Williams (1998), Plouffe (1999), and Mate and Levson (in press). For instance, the maximum gold level in the study area (79 ppb) is located at least 700 metres up-ice from the April and CH porphyry prospects which suggest that more mineralized bedrock might be concealed by glacial sediments in that region (Map 3, Sheet 1 in pocket) (O'Brien et al., 1997; Weary et al., 1997). A series of high gold concentrations (>9 ppb) located on Lower and Middle Jurassic bedrock north and northeast of Suscha Lake (93F/1) are not related to known mineral occurrences. Yet, these high gold levels could be located over the same bedrock type that hosts epithermal mineralization in the study area. Another group of dispersed high gold levels are located southwest, northwest and northeast of Finger Lake. Only the Finger Lake (Fe) and Tat (Cu) showings are known in this region. Eocene (Ootsa Lake Formation) and Jurassic (Hazelton Group) bedrock, host of epithermal mineralization deposits, most likely underlie this region. Other new areas of interest include sites of anomalous gold concentrations (>99th percentile) at the northwest end of Cheslatta Lake, on the north shore of Ootsa Lake, south of François Lake, west of Tahultzu Lake, southeast of Hallett Lake, and north and northwest of Tsacha Lake. None of these sites occur near reported mineral occurrences highlighting the potential for new discoveries in these areas. In addition, several of these sites show multi-element anomalies and some show elevated gold concentrations at two or more adjacent sites.

Gold pathfinder elements

Several elements are considered pathfinder elements for gold exploration because

minerals enriched in these elements are often associated with gold mineralization in bedrock. Geochemical results for the following pathfinder elements are discussed below: arsenic (e.g. of mineral association: arsenopyrite, realgar), barium (barite), mercury (cinnabar), and antimony (stibnite). Although these elements are considered pathfinder elements for gold, their correlation coefficient with gold calculated from the regional data are not significant at the 95th percent confidence level. Therefore, these elements are only useful for gold exploration for specific types of deposit or in specific areas within the Nechako River map area. For example, elevated antimony does not occur with anomalous gold in till at the Wolf epithermal gold prospect and elevated arsenic only occurs in till derived from the Blackfly zone and not the ridge zone (Levson and Giles, 1997). Of the 13 till sites in this study with gold concentrations greater than the 99th percentile, four show >80th percentile arsenic concentrations and three of these same sites show >90th percentile antimony concentrations.

Arsenic

Arsenic concentrations were determined in the clay-sized fraction by ICP-AES and in the silt and clay-sized fraction by ICP-AES and INA. Eleven percent of the clay-sized samples yielded concentrations below detection limit (2 ppb). On the other hand, 23 % of the silt and clay-sized fraction analyzed by ICP-AES yielded concentrations below detection limit and only one sample of the same size fraction analyzed by INA returned a value below detection. Arsenic concentrations determined by ICP-AES are higher in the clay-sized fraction than in the silt and clay-sized fraction (Table 8). However, the analytical precision of arsenic determinations is better by INA analyses ($\pm 21\%$) than by ICP-AES ($\pm 73\%$ and $\pm 40\%$; Table 4). Only the INA results are plotted on Map 4, Sheet 1 (in pocket). The maximum concentration (170 ppm) is located about one kilometre southeast of the Buck showing. The highest arsenic concentrations (>25 ppm) are dominantly present in the south central part of the study area in regions underlain by Lower and Middle Jurassic volcanic and sedimentary rocks, and the Laidman Batholith. New sites with greater than 99th percentile arsenic concentrations that do not occur near reported mineral showings include sites south and west of Chelaslie Arm, southwest of

Moose Lake, north of Tsacha Lake, north of Knewstubb Lake, and southwest of Euchiniko River.

Barium

As for arsenic, barium concentrations were determined in the clay-sized fraction by ICP-AES and in the silt and clay-sized fraction by ICP-AES and INA. No sample returned a concentration below detection limit. Barium determinations by INA are significantly higher than the ones by ICP-AES (Table 8) because barite is not dissolved by aqua regia (Hall, 1991) (acid attack used prior to the ICP-AES analyses). In other words, aqua regia represents a partial leach for barium because of its ineffectiveness at destroying barite.

The barium concentrations determined by INA on the silt and clay-sized fraction are highest on the Jurassic bedrock southeast of Knewstubb Lake and southwest of Ootsa Lake (Map 5, Sheet 1 in pocket). A large cluster of sites with high barium concentrations is approximately centered on the Holy Cross gold epithermal showing north of Knewstubb Lake (Plouffe, 1999). This cluster of high barium levels correlates very well with a cluster of high strontium levels as determined in the clay-sized fraction of till (ICP-AES) analyses. The Holy Cross showing could partly be the source of the high barium levels in till because barite is present as a gangue mineral at that locality. However, several sites with high barium levels are located up-ice from the Holy Cross showing which suggest that the known mineralization at Holy Cross might not be the sole source of barium. High barium levels in till could be indicative of buried epithermal mineralization because barite can occur as a gangue mineral in epithermal systems. Other greater than 99th percentile barium concentrations occur at three sites north of the Chu mineral occurrence and at one site midway between Intata Reach and Chelaslie Arm.

Mercury

Mercury analyses were only conducted on the clay-sized fraction by CV-AAS. One percent of the samples yielded a concentration below the detection limit of 10 ppb.

Most mercury concentrations >211 ppb (>90th percentile) are located on felsic and mafic Tertiary volcanic rocks north of Ootsa and Natalkuz lakes and south of Euchiniko River

(Map 6, Sheet 1 in pocket). The Stubb showing, located on the north shore of Knewstubb Lake, is reflected in till with a high mercury concentration (470 ppb). Two other sites with >99th percentile mercury levels occur northwest and southeast of the Stubb showing. Previous studies have indicated high levels of mercury in the clay-sized fraction of till down-ice from faults in central British Columbia (Plouffe, 1995a, 1995b, 1998a). Therefore, some of the high mercury levels measured in the Knewstubb Lake region could be derived from concealed mercury mineralization focused along recently mapped faults in the area (Anderson et al., 1998). Three other sites with >99th percentile mercury concentrations occur northeast of Intata Reach in a region underlain by Eocene volcanics.

One of the environmental concerns within the study area is the potential remobilization and accumulation of mercury in aquatic biota because of under-water log pulling activities in the Nechako Reservoir. (Log pulling is a method used to recover submerged trees still present in growing position in the deeper portions of the Nechako Reservoir.) Concerns were nourished following the identification of localized high mercury levels in till near the Nechako Reservoir (Plouffe and Williams, 1998). However, a field experiment conducted by BC Research Inc. indicated that freshwater mussels placed in Nechako Reservoir for 90 days during log pulling activities showed no significant enrichment in their total mercury and methyl-mercury concentrations (McDevitt et al., 1999).

Antimony

Antimony analyses were conducted by ICP-AES and INA analyses. All silt and clay-sized samples analyzed by ICP-AES returned concentrations below detection limit (< 2 ppm) and results on the clay-sized fraction with the same analytical method generally showed poor reproducibility (Appendix 1 and Table 5). Consequently, only the results of INA analyses are considered here. None of the samples analyzed by INA yielded a concentration below detection limit. A large cluster of high (>3.2 ppm) antimony levels is present southeast of Knewstubb Lake which seems to be derived from the underlying Jurassic volcanic and sedimentary rocks of the Ashman and Naglico formations (Map 7, Sheet 1 in pocket). In the same region, high antimony concentrations on the bedrock of

the Cheslata Lake Suite (MCL on the bedrock geology map) might be related to northeastward glacial dispersal of antimony rich debris derived from the Jurassic rocks. There are no high antimony levels associated with the Naglico Formation north of Tetachuk Lake which suggests that the antimony enrichment is not diagnostic of the entire Naglico Formation but is probably localized and could be reflecting mineralization. This is supported by the presence of anomalous (>99th percentile, >6 ppm) antimony levels in till at the Blackwater-Davidson and Ben mineral showings. Another large concentration of sites with elevated (>95th percentile, >3.8 ppm) or anomalous (>99th percentile, >6.0 ppm) antimony concentrations occur north of Ootsa Lake, in an area underlain by felsic and mafic volcanic rocks (EE and EO on the bedrock geology map) but peripheral to a Cretaceous or Tertiary intrusion (LKU on the bedrock geology map). Gold concentrations are also locally elevated in this area suggesting the potential for associated gold mineralization.

Base metals

The study area is characterized by a few isolated sites with high concentrations of copper, lead, and zinc which could be potential mineral exploration targets.

Copper

None of the clay- or silt and clay-sized samples returned a copper concentration below detection limit. Copper concentrations are higher in the clay-sized than in the silt and clay-sized fraction (Table 8) for reasons outlined by Shilts (1975). The highest copper concentration (706 ppm) was measured in the clay-sized fraction of a sample located 10 km to the southwest of Hallet Lake in the same region where a series of high barium and strontium levels were detected (maps 8 and 9, Sheet 1 in pocket). Some high copper levels in both size fractions are located directly over or down-ice from intrusive rocks and could indicate the presence of disseminated sulphides in these rocks. Examples include anomalous (>99th percentile) copper concentrations at sites down-ice of the Eocene intrusions that host the Tet and Ben mineral showings. Sites with greater than 99th percentile copper concentration that do not occur near known mineral occurrences

include three sites in one area north of Tsacha Lake (silt and clay-sized fraction) and three isolated sites between Finger Lake and the Nechako River (clay-sized fraction). Till over the bedrock of the Cheslatta Lake Suite in the southeastern sector of the study area contains higher background copper concentrations compared to the rest of the region.

Lead

As is the case for copper, lead concentrations are generally higher in the clay-sized fraction. None of the clay-sized samples and only 2% of the silt and clay-sized samples yielded a concentration below detection limit. The highest lead concentration (280 ppm) was detected in the clay-sized fraction of the sample that also contains the highest copper level mentioned above. The largest cluster of sites with high lead levels in the clay-sized fraction is located north of Hallet Lake and seems to be associated with Middle to Late Jurassic intrusive rocks (maps 10 and 11, Sheet 1 in pocket). There are no known sources of lead in bedrock near these sites with high lead levels. Three zones of known sulphide mineralization (Buck, CH, and Blackwater-Davidson showings) are well reflected with high Pb levels in the silt and clay-sized fraction. Two sites of interest that show greater than 99th percentile lead concentrations (in both analyzed size fractions) occur down-ice or over intrusive rocks located south of François Lake (Eu on bedrock geology map) and west of Tahultzu Lake (MJS on bedrock geology map). Another area with high lead and zinc levels occur southeast of Moose Lake.

Zinc

No sample yielded a zinc concentration below the detection limit. The highest zinc concentration (471 ppm) was measured in the silt and clay-sized fraction (471 ppm) of a sample located over felsic volcanic rocks of the Ootsa Lake Formation, about 19 km NNW of Tsacha Lake (maps 1 and 2, Sheet 2 in pocket). South of François Lake, two adjacent till samples yielded high zinc levels in the clay-sized fraction (>231 ppm). No known mineral occurrences are present in the vicinity of these high zinc levels in till. The highest zinc concentrations in the silt and clay-sized fraction are dominantly located in the southern part of the study area over the Jurassic rocks. Some of the high values on

NTS map sheets 93F/3, and F/7 could be related to concealed mineralization (Levson et al., 1994; Weary et al., 1997). Sites with zinc concentrations greater than the 99th percentile in the silt and clay-sized fraction (>107 ppm) that do not occur near known mineral occurrences include two sites southeast of Moose Lake, two sites northwest of Tsacha Lake, and three sites southeast of Knewstubb Lake. Sites with similarly high zinc levels in the clay-sized fraction include one site along the Euehiniko River and the same two sites with high lead concentrations down-ice of intrusive rocks (discussed above).

Molybdenum

Molybdenum concentrations were determined in the clay-sized fraction by ICP-AES and on the silt and clay-sized fraction by ICP-AES and INA analyses. Results of molybdenum analyses on duplicate samples by INA returned results with low precision ($\pm 167\%$) (Appendix 1 and Table 5). The analytical precision of ICP-AES analyses on the clay-sized fraction is slightly better ($\pm 55\%$) but could not be evaluated for the silt and clay-sized fraction because most duplicate samples returned concentrations below detection limit (1 ppm). Given the spurious results of molybdenum analyses by INA, only the ICP-AES results are discussed here.

Molybdenum concentrations in the clay-sized and the silt and clay-sized fractions are low and very near detection limit in most samples. The average and median concentrations in both grain size fractions are at detection limit (1 ppm) (Table 8). More than 56% of the clay-sized and 28% of the silt and clay-sized samples returned concentrations below detection limit. Because of the low analytical precision for molybdenum determinations and the generally low molybdenum concentrations present in the samples, subtle variations in background molybdenum concentrations are considered insignificant. For instance, all samples on 93 F/5 and F/12 map sheets show a slightly higher background molybdenum concentration (2-3 ppm) in the clay-sized fraction compared to the rest of the area. In addition, none of the silt and clay sized fraction samples on map sheets F/2, F/3, and F/7 yielded molybdenum concentrations below the detection limit and all samples on F/13 returned values below detection limit. These observations are thought to be related to an analytical artifact because variations of molybdenum concentrations do

not follow bedrock contacts but rather follow map sheet boundaries. The source of the problem could be a slight variation in the analytical accuracy for molybdenum. For instance, clay-sized samples from the F/5 and F/12 map sheets were analyzed together in one batch with a standard (TCA-8010) which returned a value of 1 ppm. TCA-8010 returned a molybdenum concentration below detection limit with all other sample batches. Consequently, it is recommended that only highly elevated molybdenum values (e.g. >98th percentile) be considered here.

Two sites with high levels of molybdenum (16 and 8 ppm) in the clay-sized fraction of till reflect the presence of molybdenum occurrences in the Nithi Mountain region east of François Lake (maps 3 and 4, Sheet 2 in pocket). Background molybdenum concentrations on Lower Jurassic intrusive rocks (2 to 3 ppm) were detected in the same size fraction at about 4 km east (down-ice) of Nithi Mountain indicating the limited extent of glacial dispersal of the molybdenum mineralization.

The highest Mo concentration in the silt and clay-sized fraction (17 ppm) is from the same sample which contains the highest value in the clay-sized fraction located near the Nithi Mountain showings. Several other known molybdenum occurrences in the region are reflected by high molybdenum levels in the silt and clay-sized fraction. For example, few samples with concentrations greater than 5 ppm reflect the presence of molybdenum mineralization at the CH and CHU showings on 93F/7 map sheet. Evidence of glacial dispersal of molybdenum might be present in the region of these three showings (Weary et al., 1997). Another cluster of high Mo concentrations southeast of Knewstubb Lake could be related to concealed mineralization near a Late Cretaceous or Tertiary intrusion (LKU on the bedrock geology map) (Weary et al., 1997). A single high molybdenum concentration (8 ppm) located along the shore of Chelaslie Arm also cannot be related to known mineralization.

Lithophile elements

Concentrations of lithophile elements in till show regional patterns that can be linked to major bedrock geology units and to glacial transport. Geochemical maps of lithophile element concentrations in the silt and clay-sized fraction are depicted on sheet 2 in pocket

(maps 5, 6, and 8). Geochemical maps for lithophile element concentrations in the clay-sized fraction are not represented because fewer samples of this size fraction were analyzed giving a lower regional representativity than with the silt and clay-sized fraction.

The interpretation of the geochemical maps of lithophile elements has to take into account the leaching potential of aqua regia used prior to the ICP-AES analyses. An aqua regia leach is known to digest sulphides, oxides and hydroxides, elements sorbed to clay minerals, carbonates, most sulphates (except barite), and certain phyllosilicates such as biotite and Mg-chlorite (Hall, 1991; Snäll and Liljefors, 2000). Aqua regia only affects the surface of minerals such as quartz, feldspars, hornblende, and epidote, and only partly leaches phyllosilicates such as Fe-chlorite and muscovite (Tarvainen, 1995; Snäll and Liljefors, 2000). The aqua regia leach is commonly used in mineral exploration because it extracts most metals of economic interest present in sediment samples.

Aluminum

Of all the phases leached by aqua regia, phyllosilicates contain the greatest amount of aluminum. Therefore, aluminum concentrations determined by ICP-AES following an aqua regia digestion give an indication of the amount of phyllosilicates such as biotite and Mg-chlorite in the samples. Most sites with aluminum concentrations greater than the 75th percentile (>1.72%) in the silt and clay-sized fraction (Map 5, Sheet 2 in pocket) and greater >4.6% in the clay-sized fraction are located over Jurassic rocks in the southern and western sector of the study area and in the region south of Nulki Lake where the bedrock is obscured by a thick cover of Quaternary sediments. The Jurassic rocks probably contain more leachable phyllosilicates such as biotite and Mg-chlorite than the Tertiary volcanics and sediments. This hypothesis could be further evaluated with XRD mineralogical analyses of the fine fraction of till.

Magnesium

Magnesium levels are generally higher over certain Jurassic rocks, notably the Naglico Formation (Diakow et al., 1997), than over Eocene bedrock in both the silt and clay- and

the clay-sized fractions (Map 6, Sheet 2 in pocket). High magnesium levels in the silt and clay-sized fraction (>95th percentile - 0.79%) are present in the eastern sector of the study area, over the Miocene Cheslatta Lake Suite. As for aluminum, the magnesium content determined by ICP-AES following an aqua regia digestion could reflect the presence of Mg-rich phyllosilicates (e.g. Mg-chlorite) (Snäll and Liljefors, 2000). The absence of high aluminum levels along with the high magnesium concentrations in till over the Miocene basalts most likely indicate that the dominant contributing minerals of magnesium and aluminum are not the same over the Jurassic and Miocene rocks.

There is a linear correlation between magnesium and copper concentrations in the silt and clay-sized fraction of till ($r=0.56$; $n=1256$). A similar correlation was pointed out by Klassen (2001) for till samples from the Nunavut Territory of Canada which he attributed to the abundance of copper in magnesium rich phyllosilicates. Furthermore, Klassen (2001) suggested that high copper values unrelated to high magnesium levels could indicate the presence of copper associated with sulphides. The presence of sulphides could be possible as long as the till samples are not oxidized. As indicated in the methodology section, till samples were collected below the oxidized soil horizon and therefore, could contain sulphides. For instance, Plouffe (1995a) noted the presence of sulphide minerals in unoxidized till samples collected at a minimum depth of one metre in the Manson River and Fort Fraser map areas, directly north of the Nechako map area. Therefore, the Cu:Mg ratio geochemical map of the silt and clay-sized fraction (Map 7, Sheet 2 in pocket) could reflect the presence of sulphide mineralization. The largest clusters of high Cu:Mg values are located southeast of Knewstubb Lake where the high ratios (>85) are associated with three zones of multi-element anomalies (areas 1, 2, 4, and 5 of Weary et al., 1997), and north of Tsacha Lake. High ratios (>85) are also found down-ice or directly above intrusive rocks of the Stagg Lake and François Lake plutonic suite. All these anomalies could reflect the presence of Cu-sulphide minerals in the silt and clay-sized fraction of till.

Sodium

Of the common minerals occurring in till, plagioclase contains the greatest sodium

concentrations. Sodium determinations by ICP-AES following an aqua regia digestion are considered partial concentrations because plagioclase is almost untouched by the aqua regia leach. On the other hand, INA analyses reflect total sodium concentrations (Klassen, 2001).

Sodium concentrations exceeding the 95th percentile (>2.69 %) dominantly occur in the Tetachuk Lake and Johnny Lake regions (Map 8, Sheet 2 in pocket). There is no clear relationship between high sodium levels and a particular bedrock unit. However, high sodium levels could be related to the Laidman Batholith (monzonite and granodiorite), although some high values appear to be located to the west (up-ice) of the intrusion. The source of the high sodium levels in the Tetachuk Lake area is unknown, but plugs, sills, and dikes of granitic to dioritic composition were mapped in that region.

Conclusion

1. The Nechako River map area was affected by regional ice flow varying in direction from easterly to northeasterly. Only the western most sector of the map area is known to have been affected by westward flow related to the eastward migration of the ice divide from the Coast Mountains to the Interior of British Columbia (Stumpf et al., 2000). Consequently, for the vast majority of the study area tracing geochemical anomalies in till relies on the reconstruction of simple ice-flow patterns.
2. Several high elemental concentrations in the fine fractions of till (clay-sized and silt and clay-sized fractions) are related to known bedrock mineralization. Therefore, till geochemistry is thought to be efficient at outlining potential zones of mineralization.
3. Several high gold levels in till are not related to known mineralization and represent potential exploration targets. However, no extensive follow-up survey should be undertaken prior to testing the reproducibility of the gold anomalies presented herein because of the low precision of gold determinations.
4. The common gold pathfinder elements arsenic, mercury, antimony, and barium

have limited usage at a regional scale within the study area because of their poor correlation with gold. However, on a more site specific basis, they could be indicative of concealed gold mineralization. Several potential areas are highlighted.

5. The source of the barium enrichment in till for a region centered on the Holy Cross showing is still undetermined and could be indicative of epithermal style mineralization.
6. High mercury levels in the clay-sized fraction of till could be related to the presence of faults.
7. Most high copper levels in the silt and clay-sized and the clay-sized fractions are associated with intrusive rocks and could indicate the presence of copper sulphides. Several sites with elevated (>99th percentile) concentrations of copper, lead and or zinc occur in areas without known mineralization such as in the areas north of Tsacha Lake and southeast of Knewstubb Lake.
8. Molybdenum concentrations in till reflect the presence of the molybdenum mineralization of the Nithi Mountain area as well as the CH and the CHU showings. However, molybdenum levels near mineralization are only slightly higher than background concentrations so that geochemical anomalies in till are subtle. Some high molybdenum levels in till are unrelated to known mineralization.
9. The lithophile elements aluminum and magnesium are thought to reflect broad regional composition changes in till which could potentially be related to a change in the clay mineralogy of the source rocks. High sodium levels could be indicative of intrusive rocks with a high plagioclase content.

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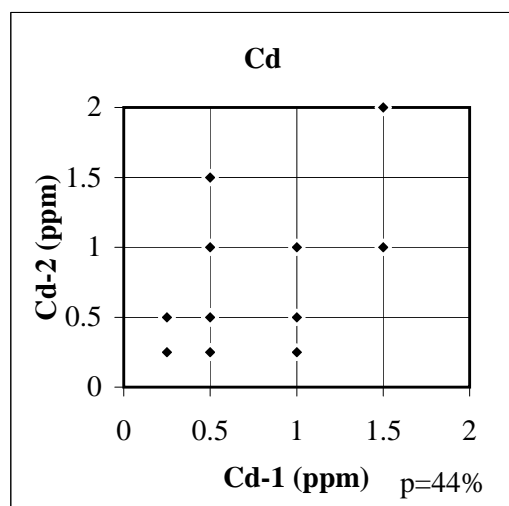
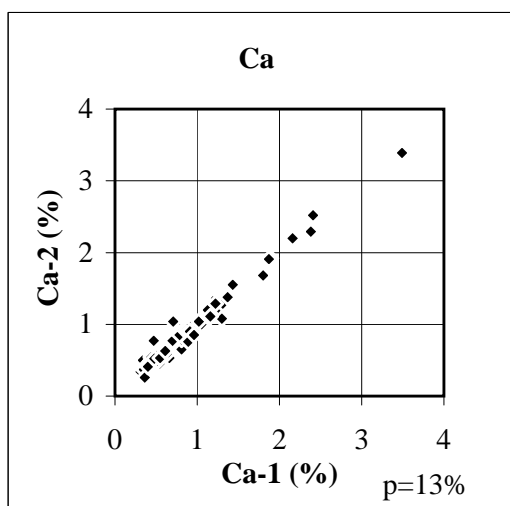
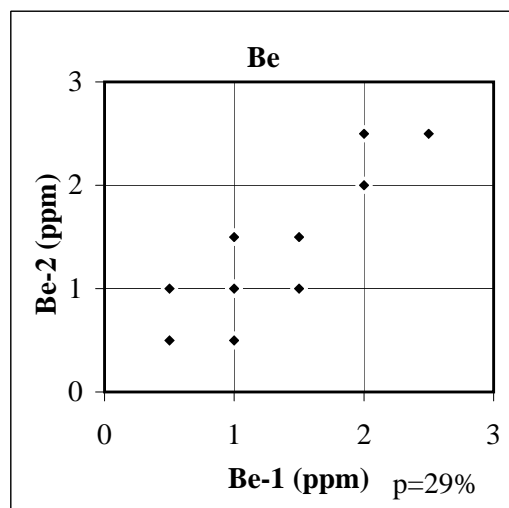
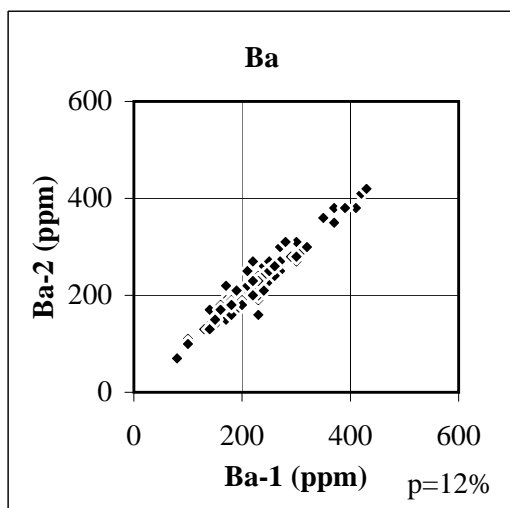
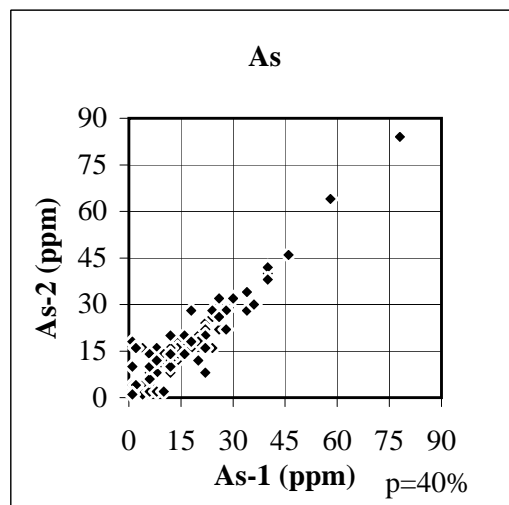
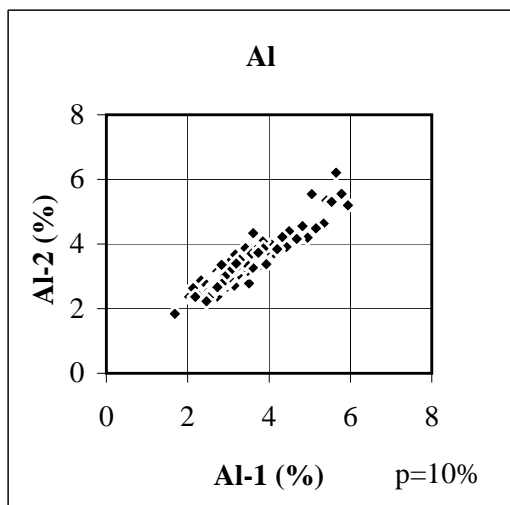
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Appendix 1

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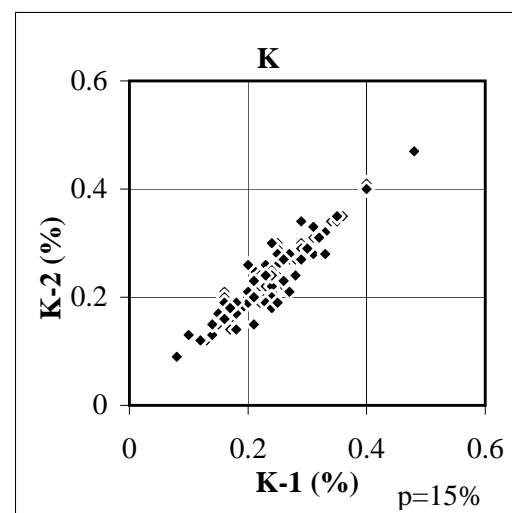
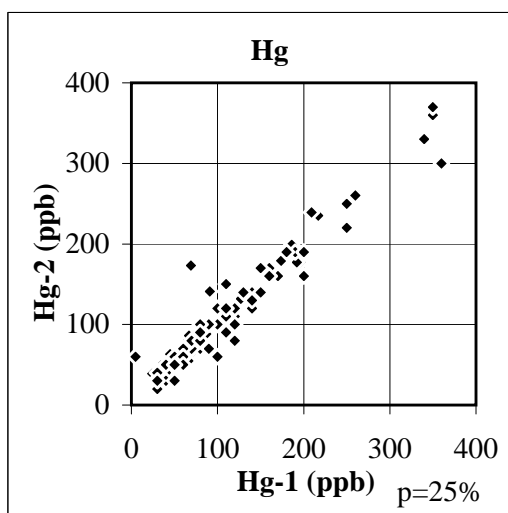
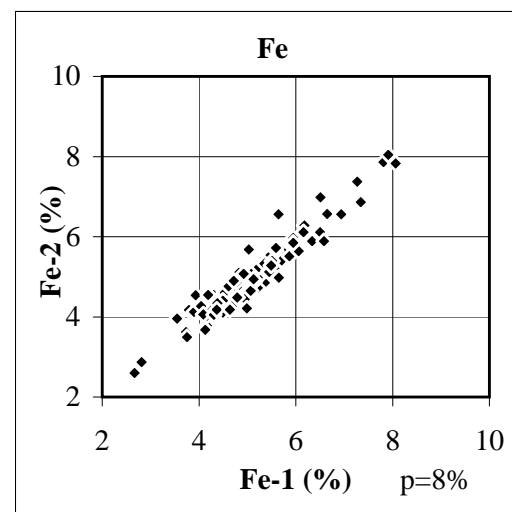
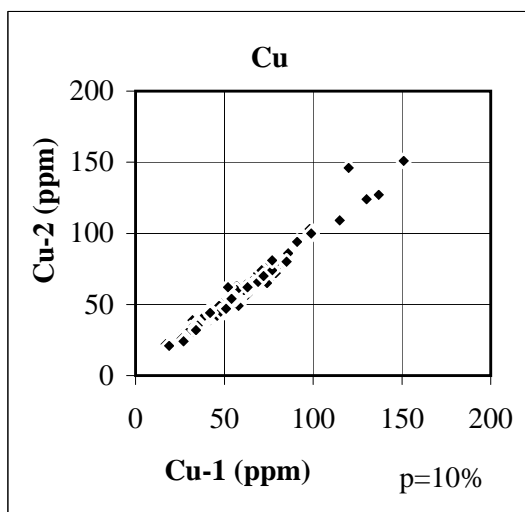
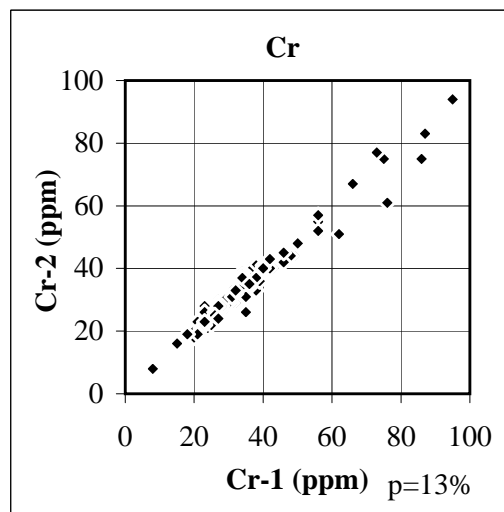
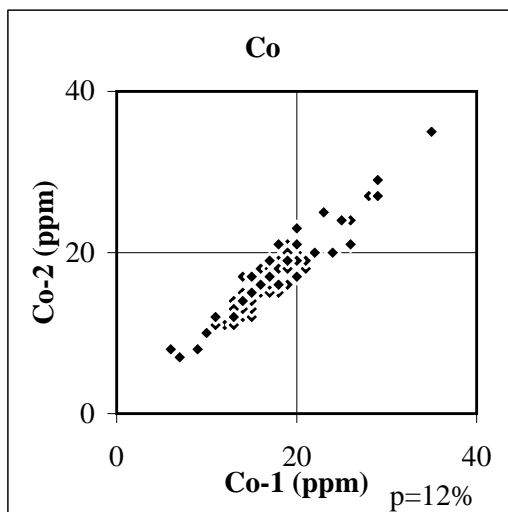
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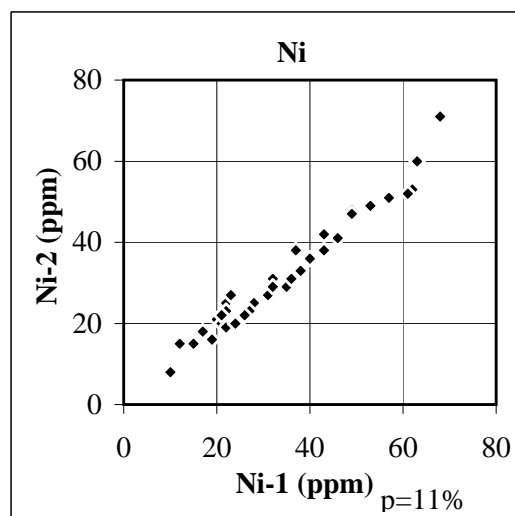
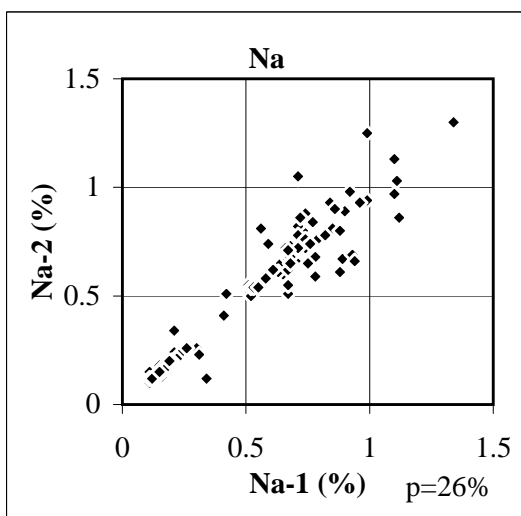
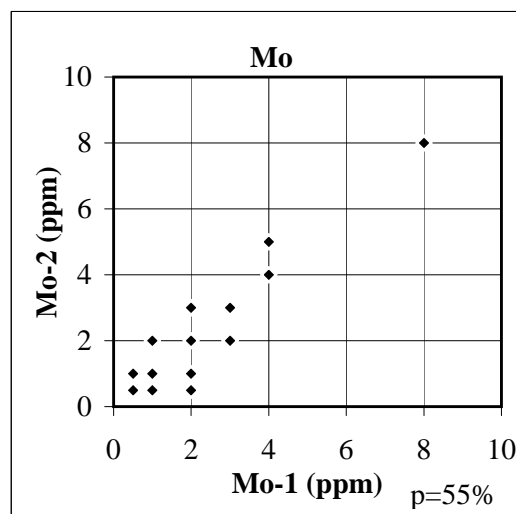
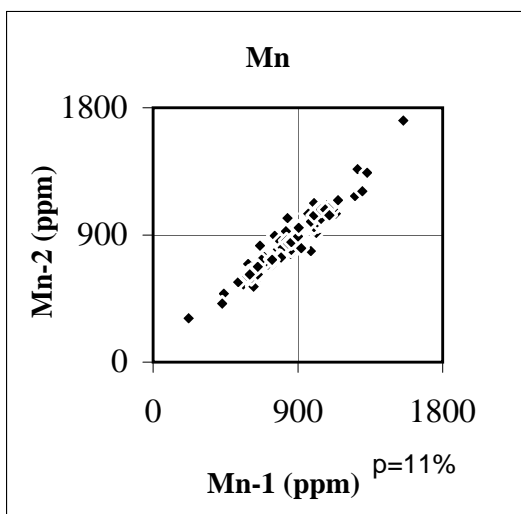
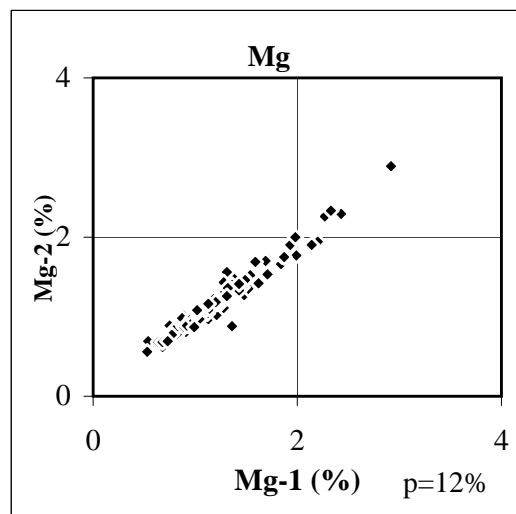
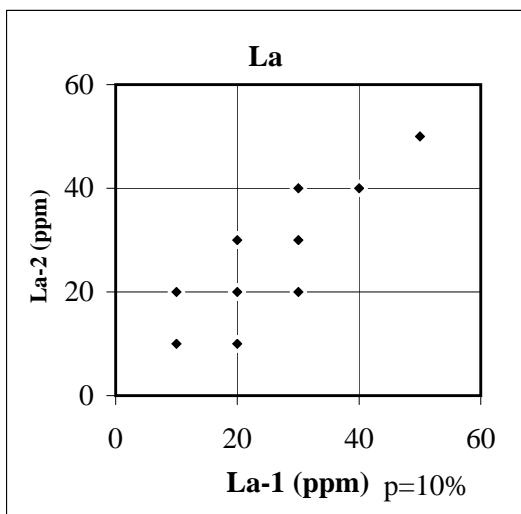
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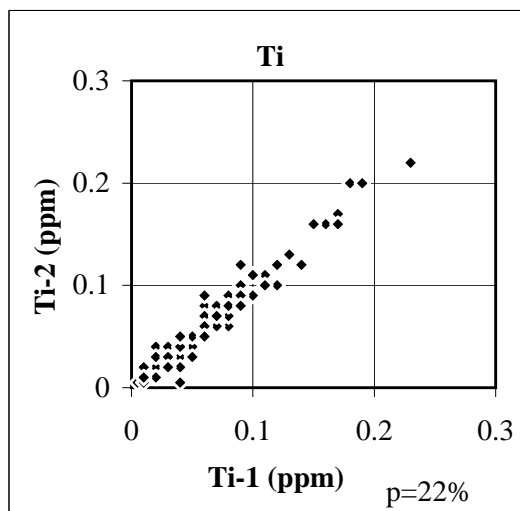
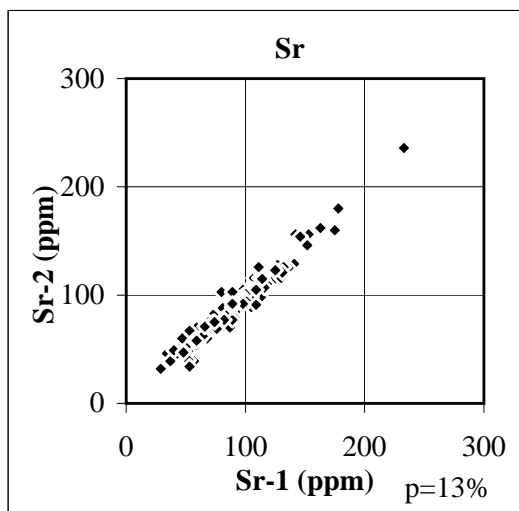
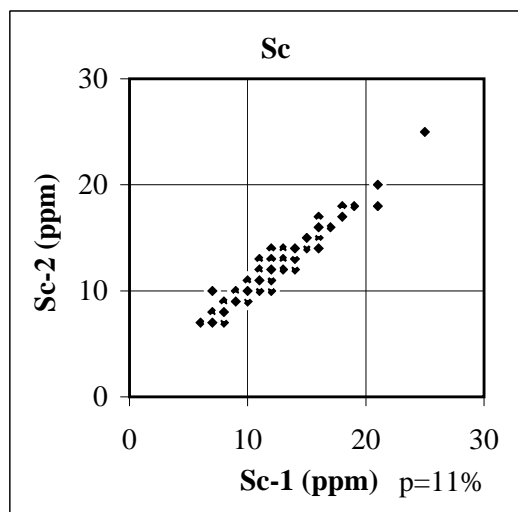
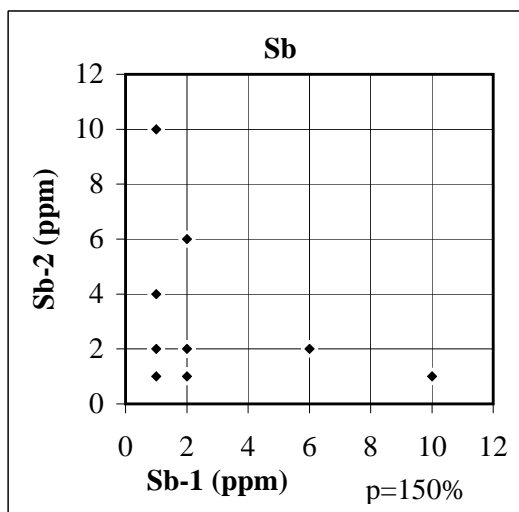
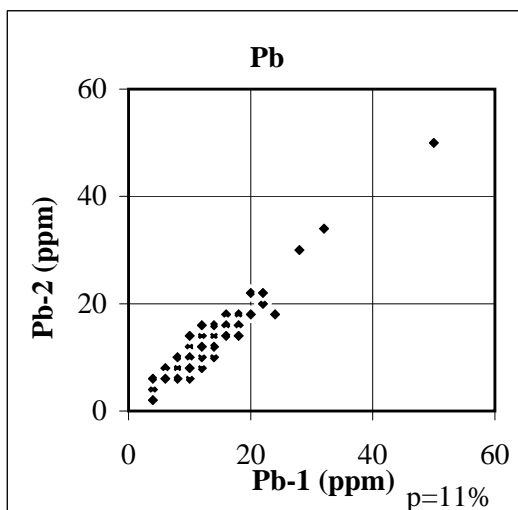
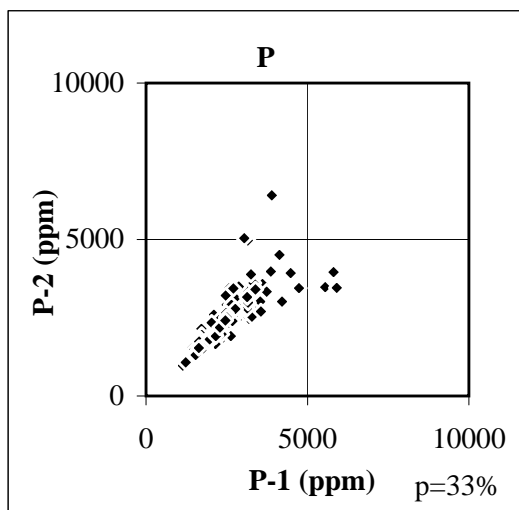
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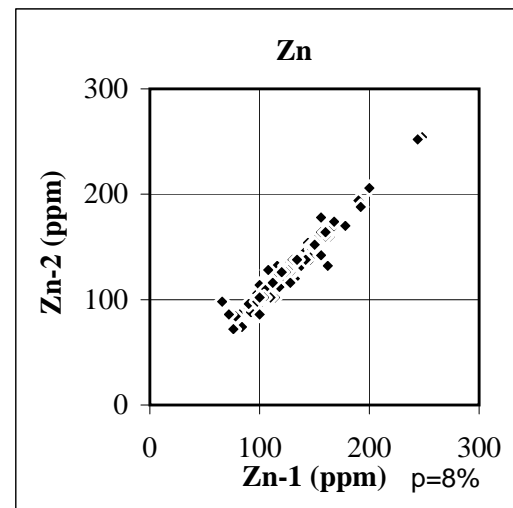
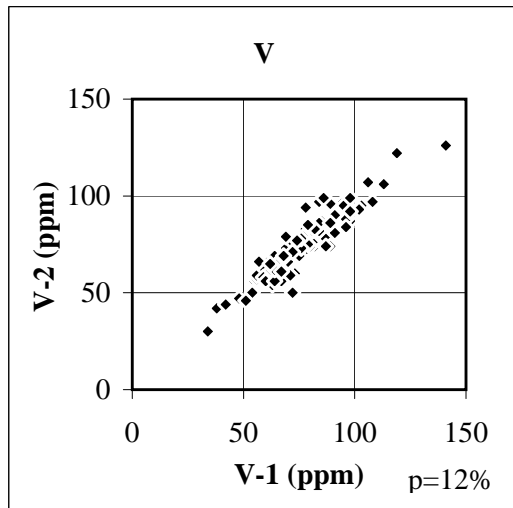
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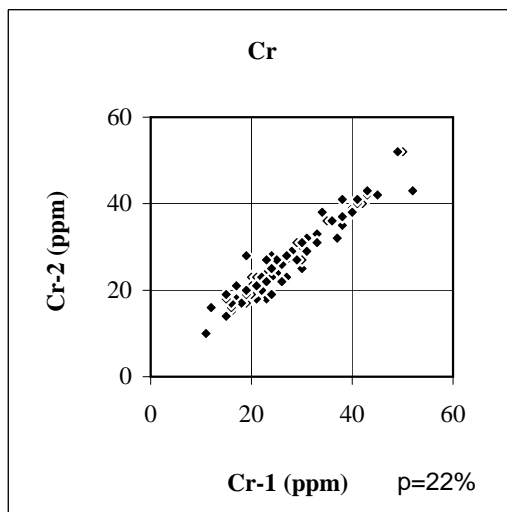
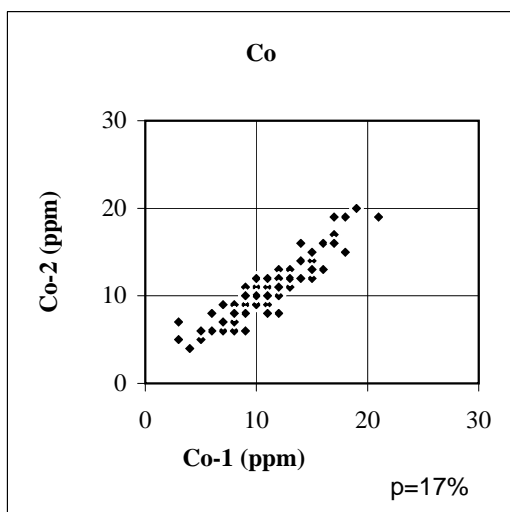
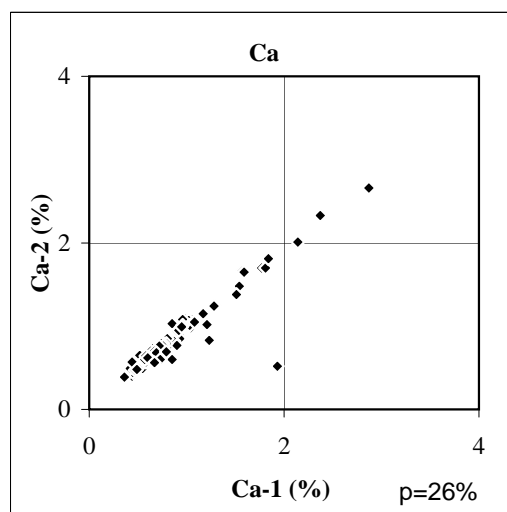
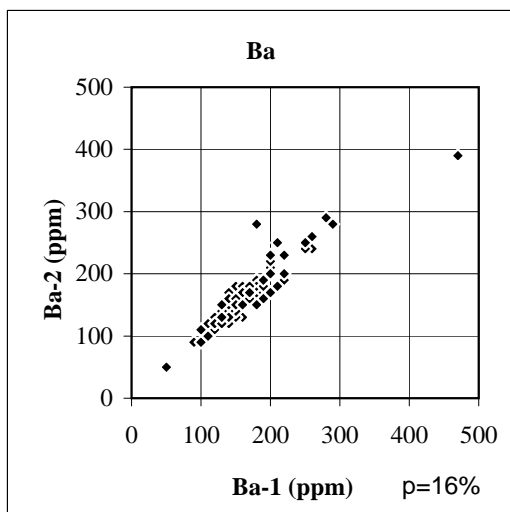
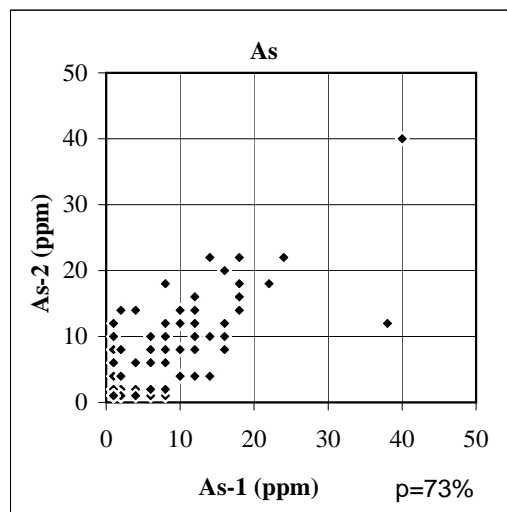
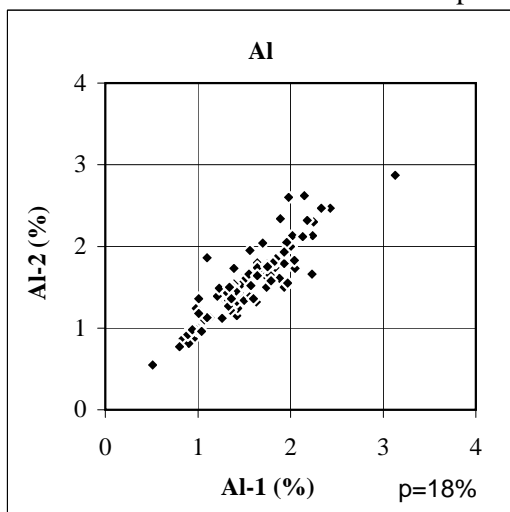
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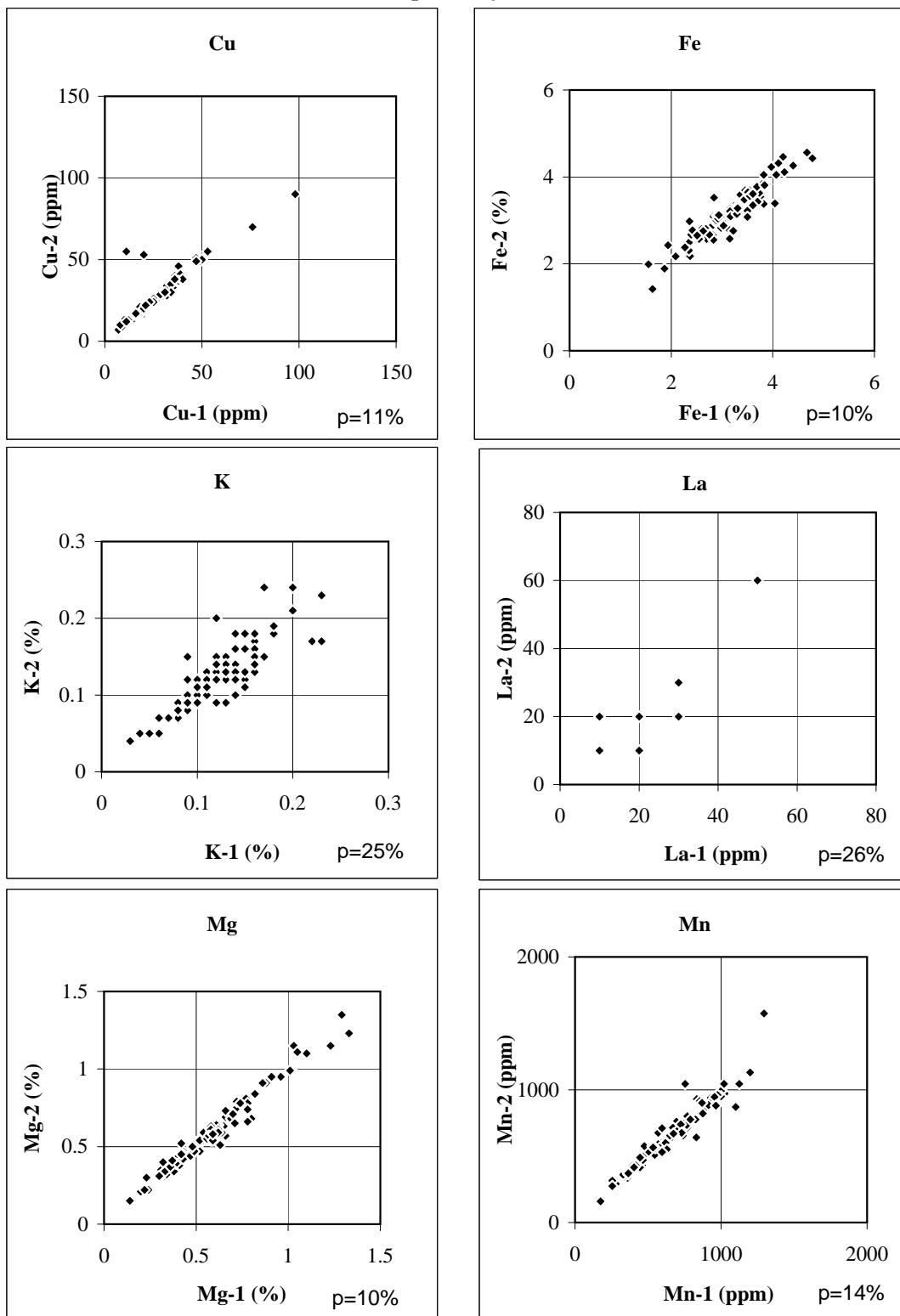
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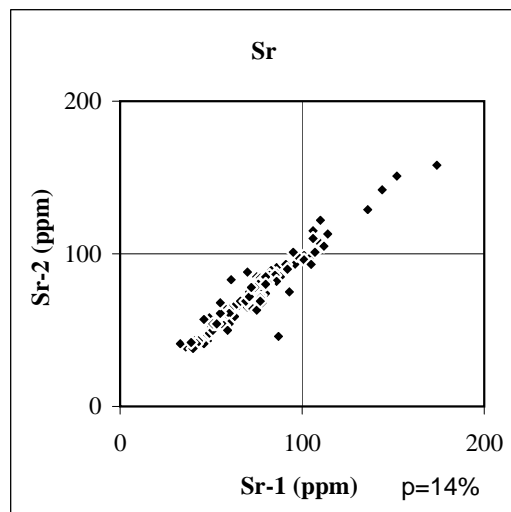
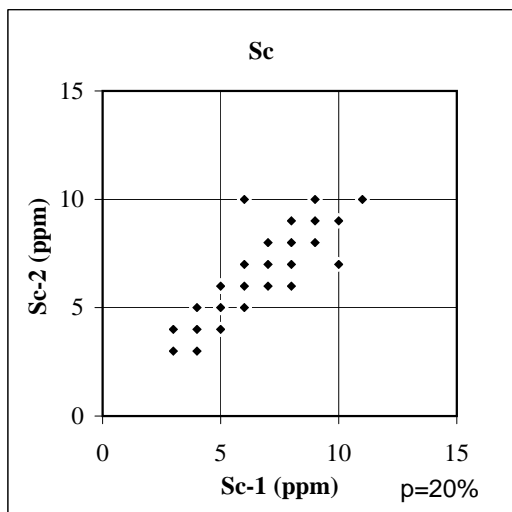
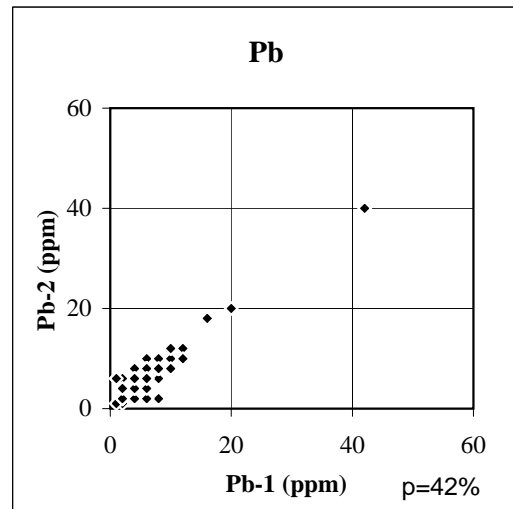
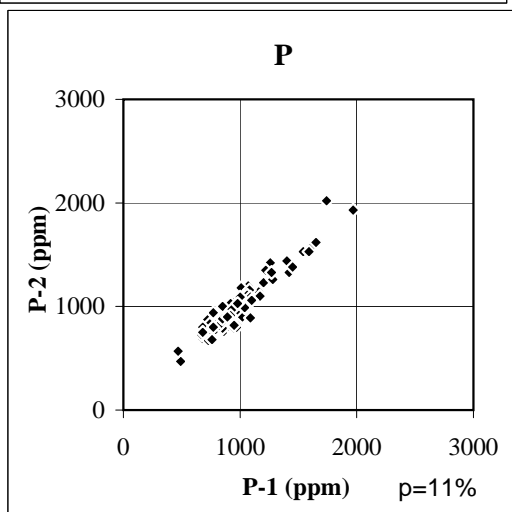
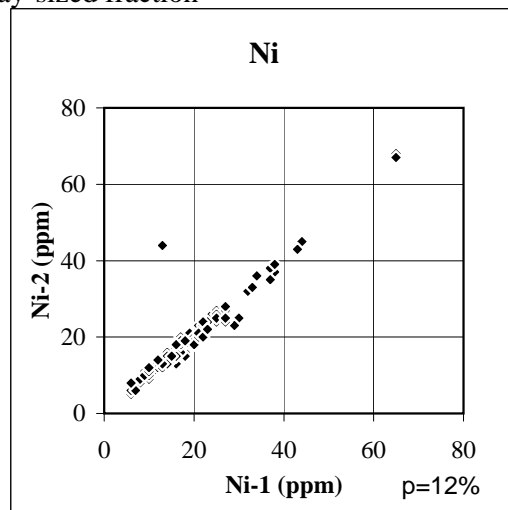
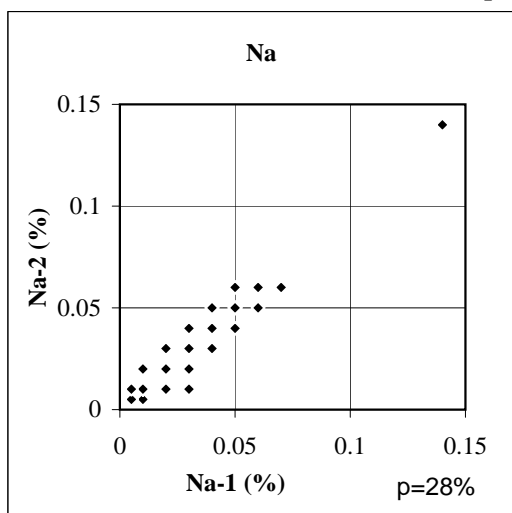
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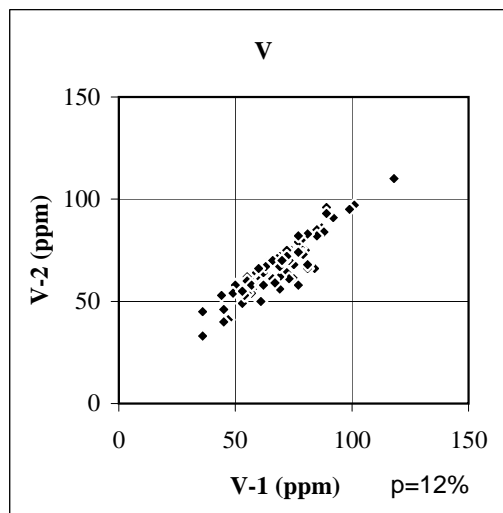
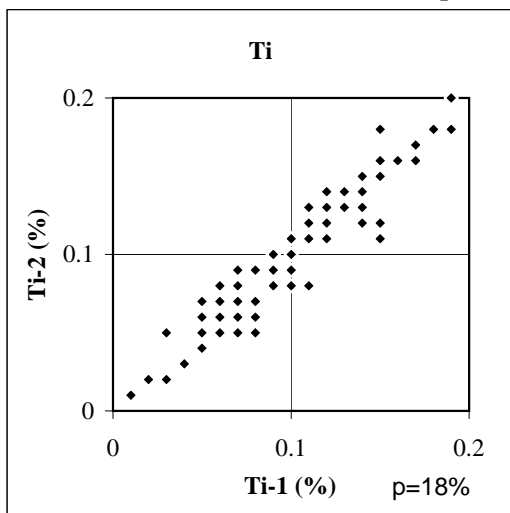
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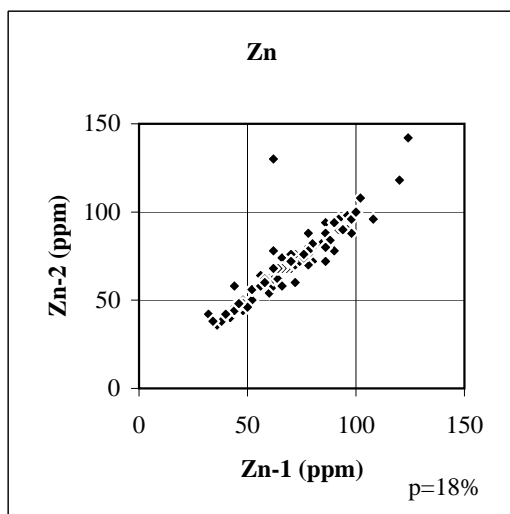


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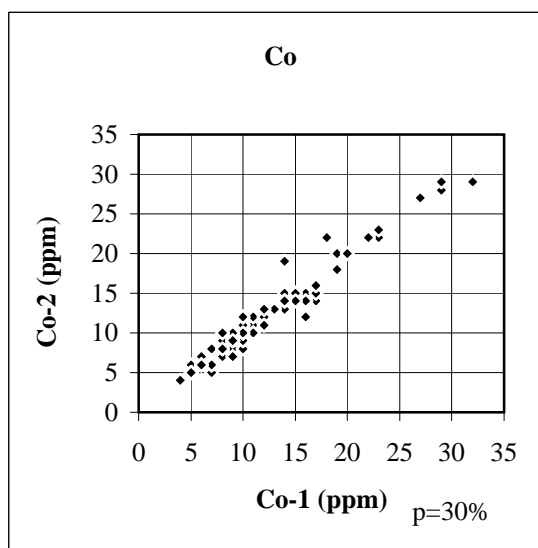
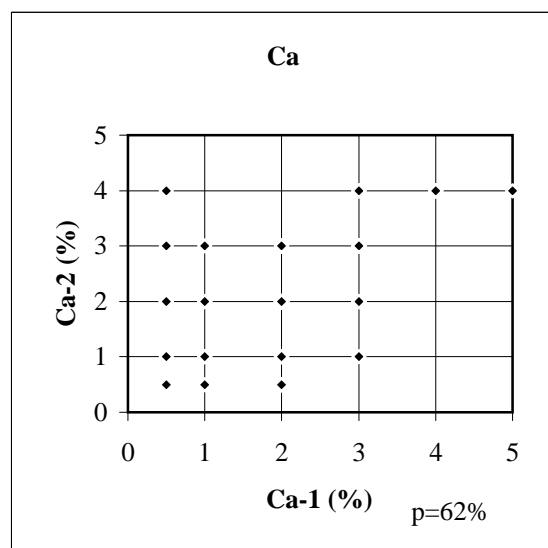
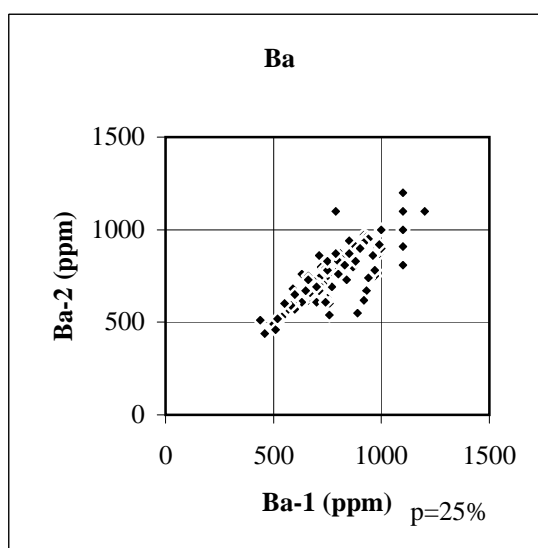
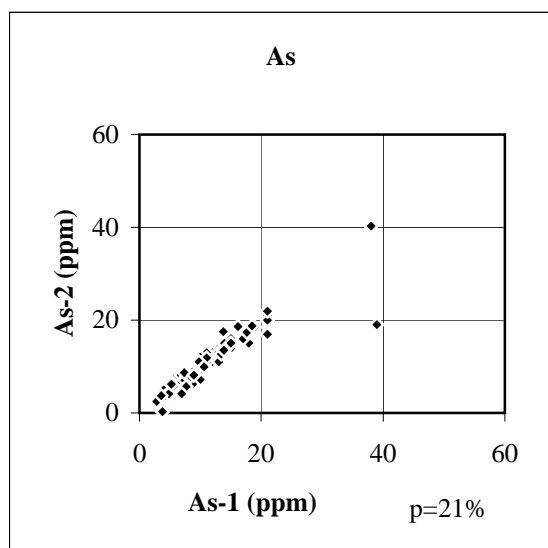
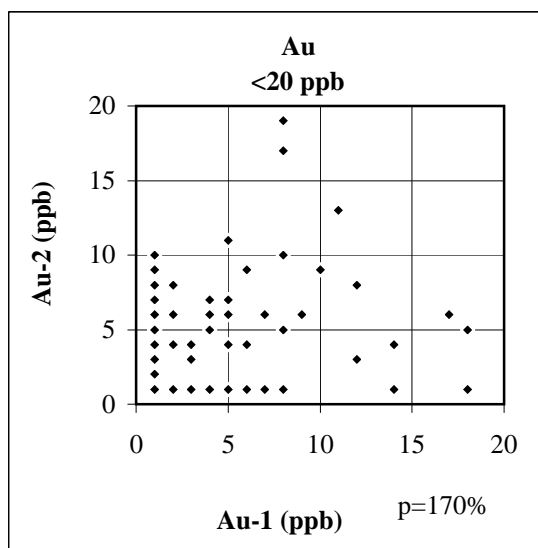
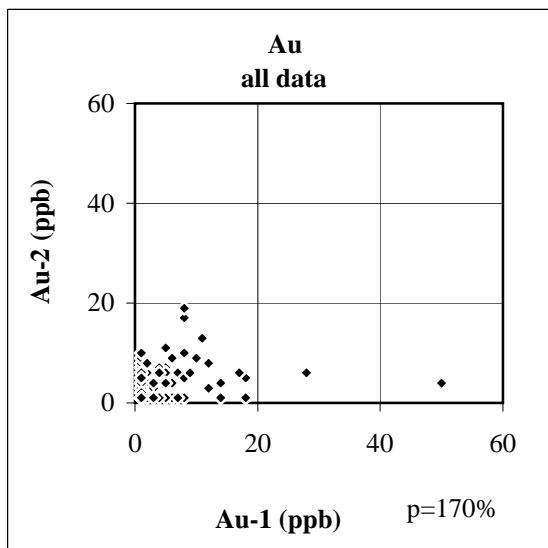
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ICP-AES analyses
silt plus clay-sized fraction



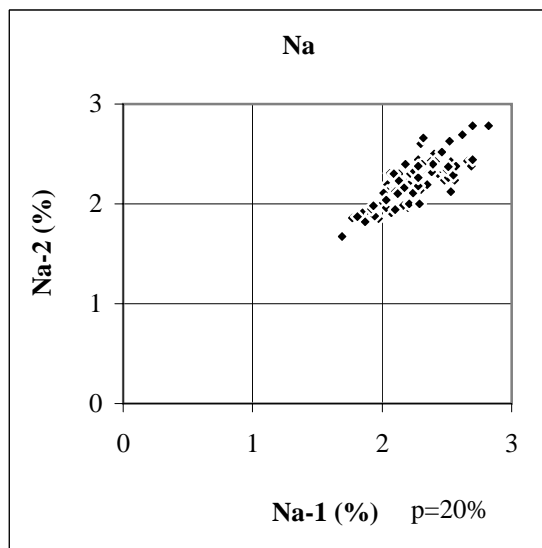
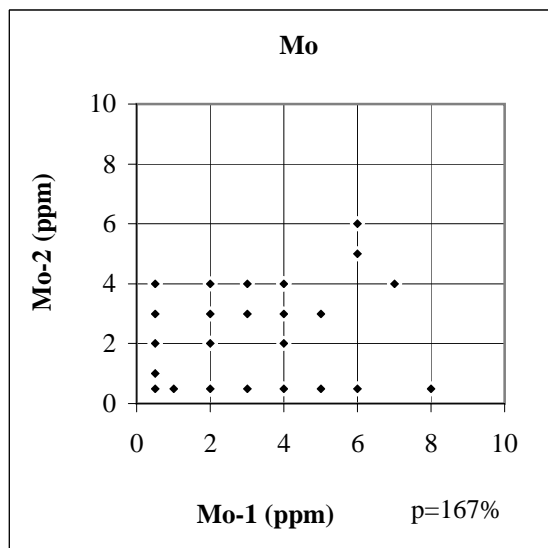
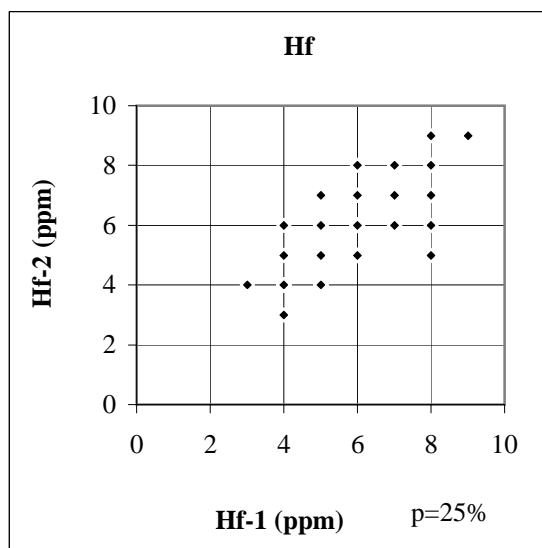
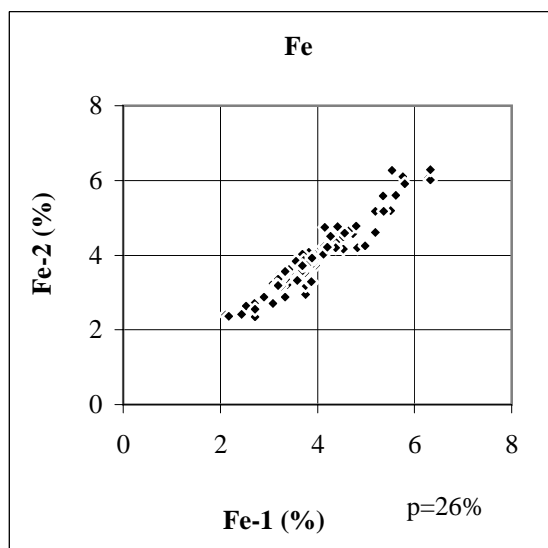
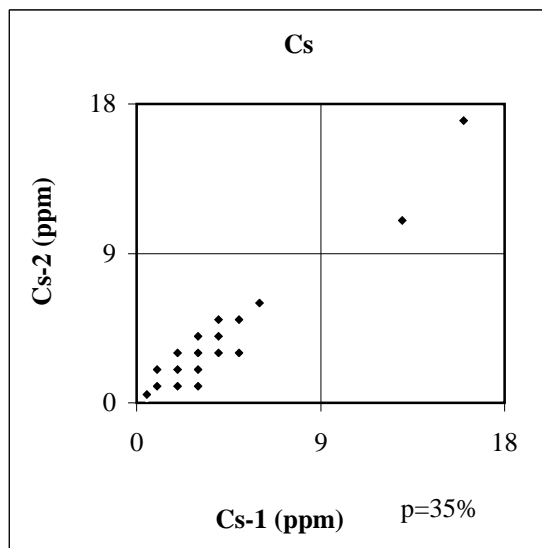
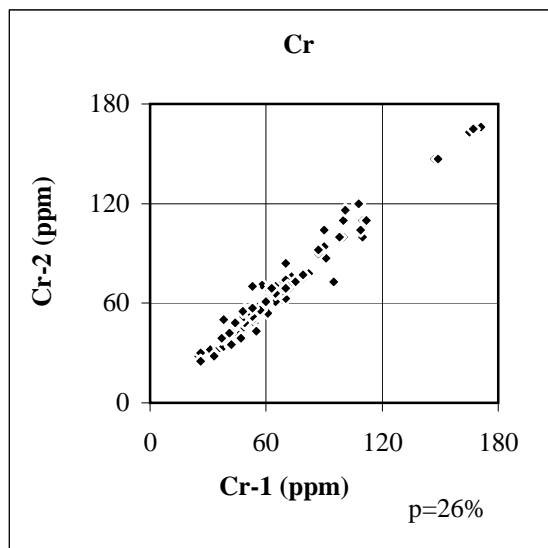
p=analytical precision



Duplicate samples
INA analyses
silt plus clay-sized fraction

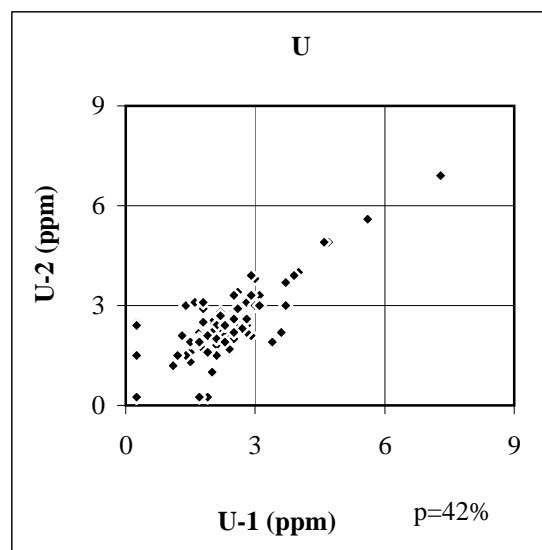
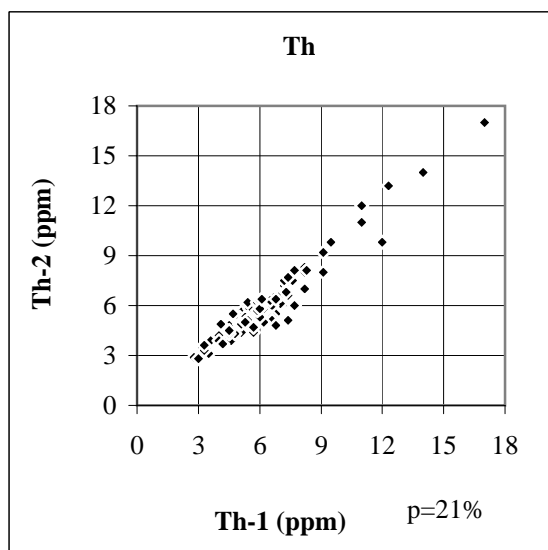
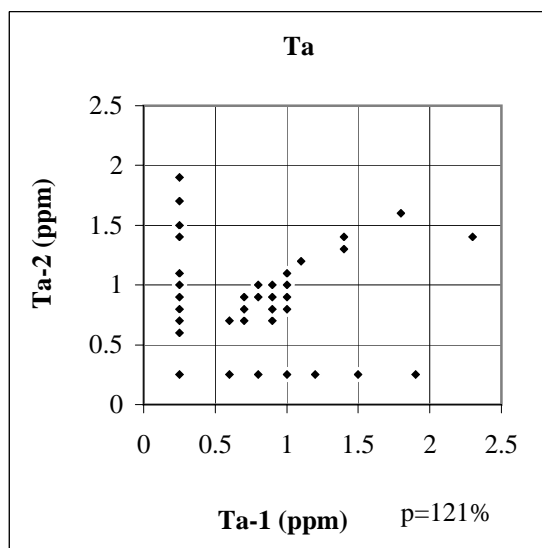
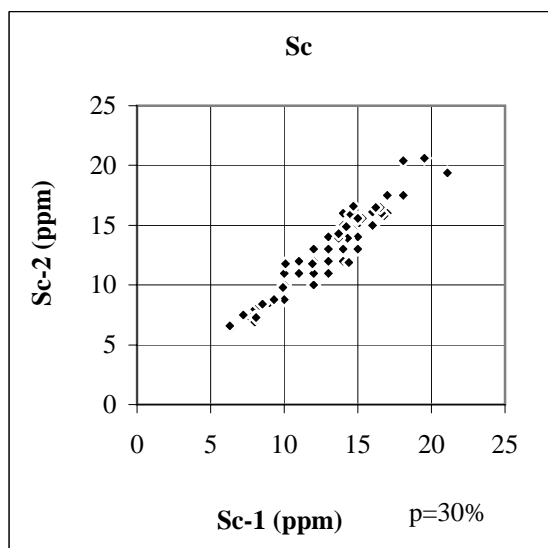
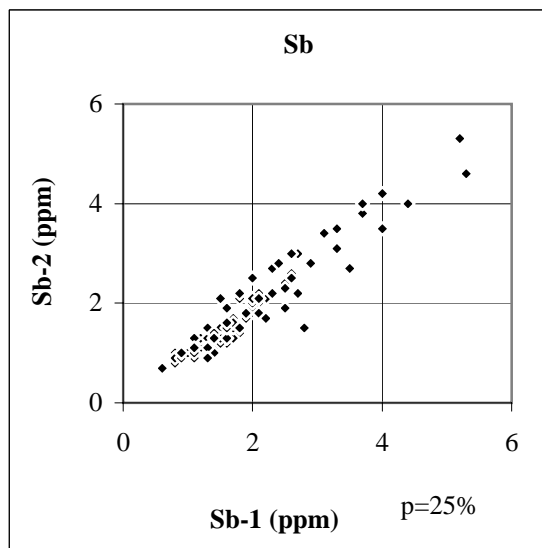
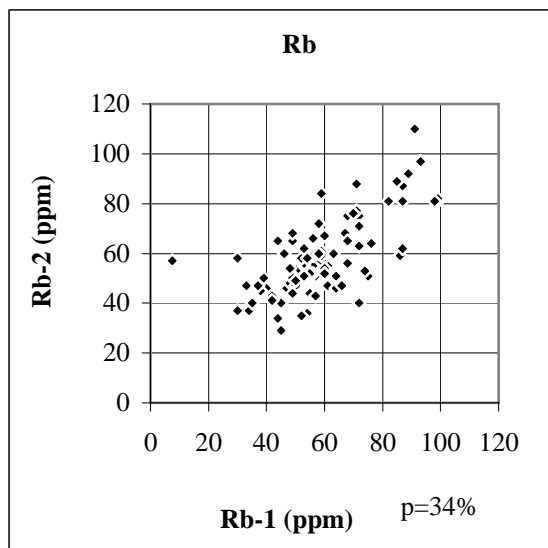


Duplicate samples
INA analyses
silt plus clay-sized fraction

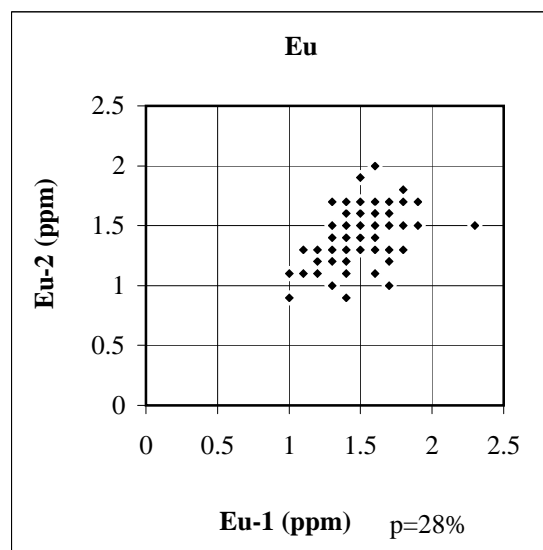
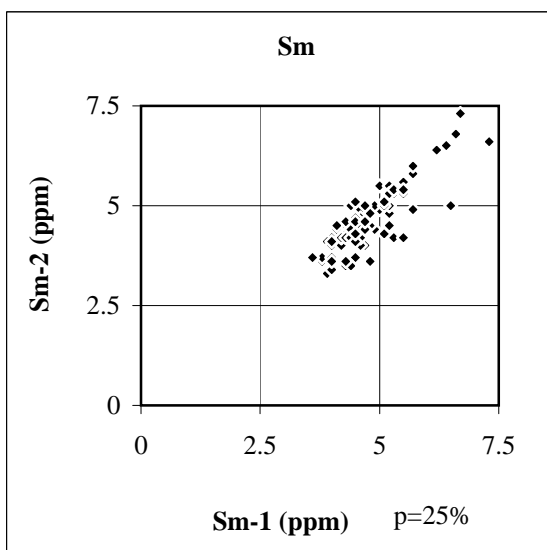
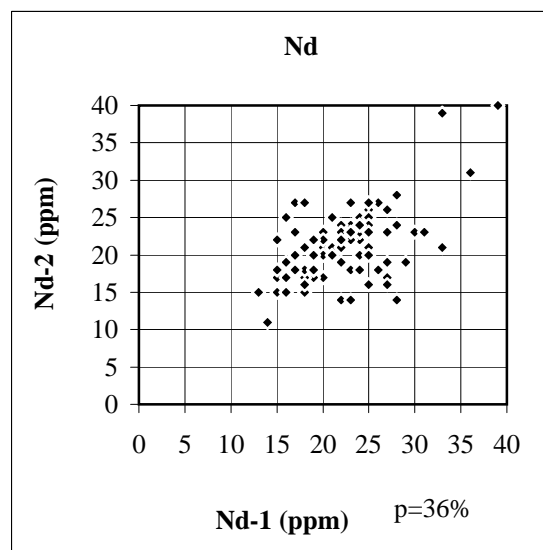
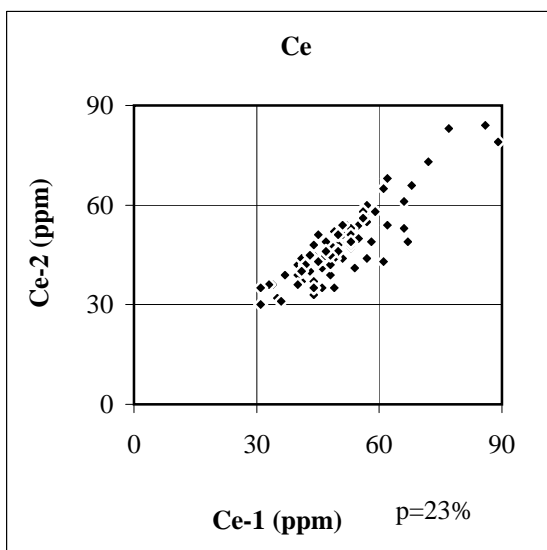
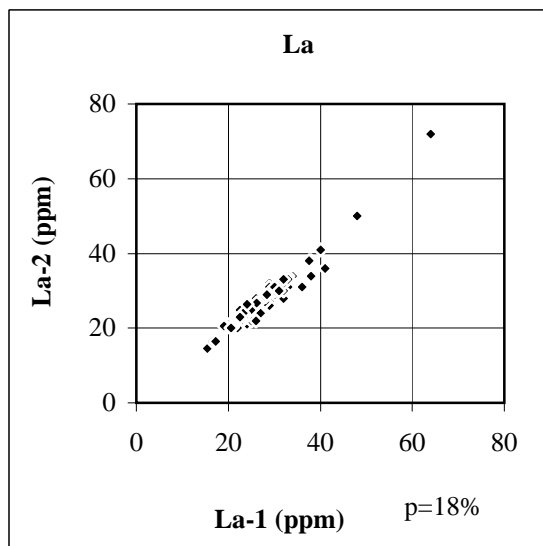
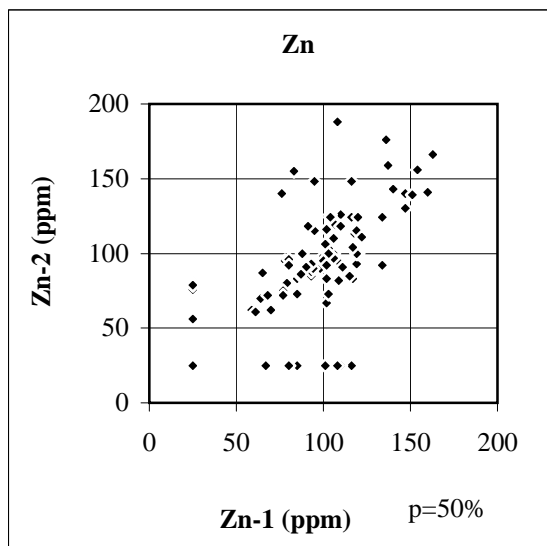


p=analytical precision

Duplicate samples
INA analyses
silt plus clay-sized fraction

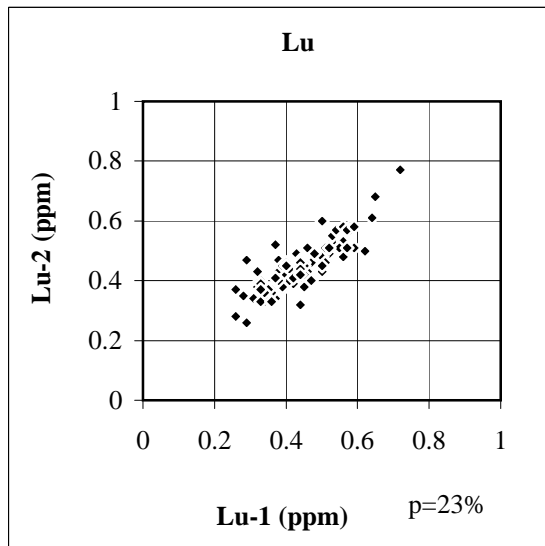
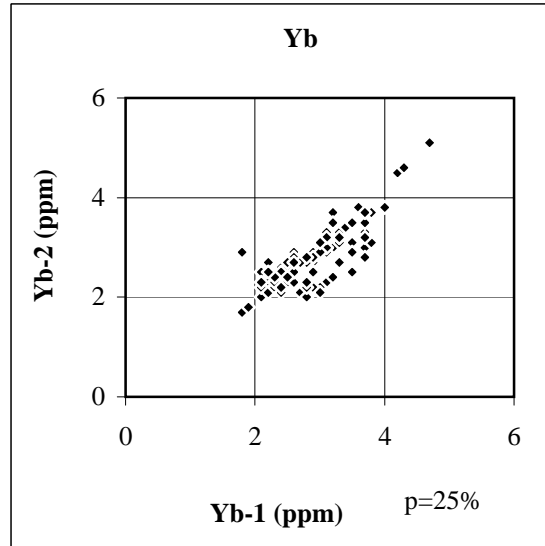
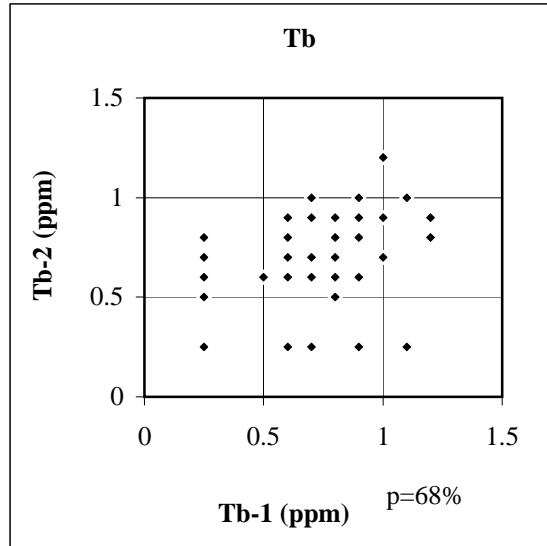


Duplicate samples
INA analyses
silt plus clay-sized fraction



p=analytical precision

Duplicate samples
INA analyses
silt plus clay-sized fraction



Appendix 2

Quality assurance / quality control:

Standard sample TCA-8010

TCA-8010
ICP-AES analyses with clay-sized fraction

TCA 8010

Element	Ag	Al	As	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	Ga	Hg*	K	La	Mg	Mn	Mo	Na	Ni	P	Pb
Unit	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppb	%	ppm	%	ppm	ppm	%	ppm	ppm	ppm
Detection limit	0.2	0.01	2	10	0.5	2	0.01	0.5	1	1	1	0.01	10	10	0.01	10	0.01	5	1	0.01	1	10	2
December 18, 1996																							
'96-PMA-021-1 -2u'	0.1	0.9	6	30	0.25	1	0.4	0.25	8	24	31	1.6	5	44	0.04	10	0.4	215	0.5	0.005	14	510	6
'96-PMA-088-1 -2u'	0.1	1	2	30	0.25	1	0.5	0.25	7	25	30	1.7	5	46	0.05	20	0.5	225	0.5	0.005	17	560	2
'96-PMA-139-1 -2u'	0.1	0.9	2	30	0.25	1	0.4	0.25	7	22	30	1.5	5	35	0.04	10	0.4	205	0.5	0.005	15	490	4
'96-PMA-171-1 -2u'	0.1	1	4	30	0.25	1	0.5	0.25	7	25	31	1.7	5	43	0.05	10	0.4	230	0.5	0.005	15	500	2
December 20, 1996																							
'96-PMA-230-1 -2u'	0.1	1	1	30	0.25	1	0.4	0.25	7	25	31	1.7	5	40	0.04	10	0.4	215	0.5	0.005	15	530	6
'96-PMA-251-1 -2u'	0.1	1	1	30	0.25	1	0.4	0.25	6	24	30	1.6	5	37	0.05	10	0.4	215	0.5	0.005	16	510	2
October 29, 1997																							
97-PL0024	0.1	0.8	6	30	0.25	1	0.4	0.25	6	21	25	1.5	5	30	0.04	10	0.4	175	0.5	0.005	13	450	0
97-PL0029	0.1	0.8	6	30	0.25	1	0.3	0.25	6	21	25	1.5	5	30	0.04	10	0.4	180	0.5	0.005	13	470	0
97-PL0034	0.1	0.8	6	20	0.25	1	0.3	0.25	6	20	26	1.5	5	30	0.04	10	0.4	175	0.5	0.005	13	480	2
97-PL0039	0.1	0.8	6	30	0.25	1	0.4	0.25	6	21	26	1.5	5	30	0.04	10	0.4	180	0.5	0.005	13	480	6
January 11, 1999																							
98PL 0442	0.1	0.9	6	30	0.25	1	0.4	0.25	7	23	29	1.5	5	30	0.04	10	0.4	200	0.5	0.01	14	450	1
98PL 0446	0.1	0.9	8	30	0.25	1	0.4	0.25	7	24	29	1.6	5	30	0.05	20	0.4	210	0.5	0.01	15	450	2
October 8, 1999																							
99IG0082	0.1	1.1	10	5	0.25	1	0.4	0.25	9	29	34	1.9	5	5	0.07	20	0.5	275	1	0.01	17	490	2
mean**	b.d.	0.90	6.75	29.28	b.d.	b.d.	0.41	b.d.	6.74	23.74	28.36	1.55	b.d.	33.08	0.05	11.45	0.39	213.33	1.15	0.02	14.49	477.25	3.19
stddev	0.00	0.11	3.14	9.44	0.00	0.00	0.05	0.00	0.82	1.92	7.41	0.16	0.00	11.47	0.02	3.55	0.03	57.45	0.36	0.02	1.17	31.05	1.71

b.d. - below detection

*-Hg analysed by CV-AAS

** - mean and standard deviation calculated from 70 recent analyses of TCA-8010, by ICP-AES after an Aqua Regia digestion.

TCA-8010
ICP-AES analyses with clay-sized fraction

TCA 8010

Element	Sb	Sc	Sr	Ti	Tl	U	V	W	Zn
Unit	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm
Detection limit	2	1	1	0.01	10	10	1	10	2
December 18, 1996									
'96-PMA-021-1 -2u'	1	4	18	0.06	5	5	27	5	32
'96-PMA-088-1 -2u'	2	5	23	0.08	5	5	29	5	30
'96-PMA-139-1 -2u'	1	5	20	0.06	5	5	26	5	26
'96-PMA-171-1 -2u'	1	5	23	0.08	5	5	27	5	28
December 20, 1996									
'96-PMA-230-1 -2u'	1	5	21	0.07	5	5	27	5	28
'96-PMA-251-1 -2u'	1	5	22	0.08	5	5	28	5	28
October 29, 1997									
97-PL0024	1	4	20	0.07	5	5	25	5	22
97-PL0029	1	4	20	0.07	5	5	24	5	22
97-PL0034	1	4	19	0.06	5	5	25	5	22
97-PL0039	1	4	22	0.07	5	5	26	5	22
January 11, 1999									
98PL 0442	1	4	19	0.07	5	5	24	5	26
98PL 0446	1	5	21	0.08	5	5	25	5	26
October 8, 1999									
99IG0082	1	6	24	0.08	5	5	30	5	30

mean** 2.18 4.57 20.61 0.07 b.d. b.d. 25.35 b.d. 27.48

stddev 0.60 0.56 3.61 0.01 0.00 0.00 3.02 0.00 6.37

b.d. - below detection

* -Hg analysed by CV-AAS

** - mean and standard deviation calculated from 70 recent analyses of TCA-8010, by ICP-AES after an Aqua Regia digestion.

TCA-8010
ICP-AES analyses with the silt and clay-sized fraction

TCA 8010

Element	Ag	Al	As	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	Ga	K	La	Mg	Mn	Mo	Na	Ni	P	Pb	Sb
Unit	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	%	ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm
Detection limit	0.2	0.01	2	10	0.5	2	0.01	0.5	1	1	1	0.01	10	0.01	10	0.01	5	1	0.01	1	10	2	2
December 19, 1996																							
'96-PMA-021-1 -2u'	0.1	0.86	6	30	0.25	1	0.38	0.25	8	24	31	1.58	5	0.04	10	0.4	215	0.5	0.005	14	510	6	1
'96-PMA-088-1 -2u'	0.1	0.95	2	30	0.25	1	0.43	0.25	6	24	32	1.62	5	0.05	20	0.4	215	0.5	0.005	15	570	2	2
'96-PMA-139-1-63u'	0.1	0.97	0	30	0.25	1	0.44	0.25	7	26	31	1.67	5	0.05	20	0.4	220	0.5	0.005	15	520	2	1
'96-PMA-171-1-63u'	0.1	0.99	2	30	0.25	1	0.42	0.25	7	23	30	1.55	5	0.05	10	0.4	225	0.5	0.005	16	530	6	1
December 19, 1996																							
'96-PMA-231-1-63u'	0.1	1	4	30	0.25	1	0.45	0.25	6	26	32	1.7	5	0.06	20	0.4	225	0.5	0.005	16	520	2	1
'96-PMA-251-1-63u'	0.1	1.01	4	30	0.25	1	0.45	0.25	5	26	32	1.72	5	0.06	20	0.4	235	1	0.005	16	500	2	1
October 28, 1997																							
97PL0044	0.1	0.93	6	30	0.25	1	0.42	0.25	7	24	30	1.58	5	0.05	20	0.4	215	0.5	0.005	15	510	2	1
97PL0049	0.1	0.89	2	30	0.25	1	0.4	0.25	6	23	29	1.51	5	0.05	20	0.4	205	0.5	0.005	15	480	2	1
97PL0054	0.1	0.75	6	30	0.25	1	0.32	0.25	6	20	27	1.31	5	0.03	10	0.3	185	0.5	0.005	13	430	1	1
97PL0059	0.1	0.97	12	30	0.25	1	0.44	0.25	6	24	31	1.71	5	0.05	10	0.4	225	0.5	0.005	15	460	2	2
January 13, 1999																							
98PL 0450	0.1	0.85	8	30	0.25	1	0.38	0.25	7	23	29	1.5	5	0.05	10	0.4	210	0.5	0.01	14	430	2	1
98PL 0454	0.1	0.91	10	30	0.25	1	0.43	0.25	7	24	29	1.59	5	0.05	10	0.4	220	0.5	0.01	14	460	2	1
<hr/>																							
mean*	b.d.	0.90	6.75	29.28	b.d.	b.d.	0.41	b.d.	6.74	23.74	28.36	1.55	b.d.	0.05	11.45	0.39	213.33	1.15	0.02	14.49	477.25	3.19	2.18
stddev	0.00	0.11	3.14	9.44	0.00	0.00	0.05	0.00	0.82	1.92	7.41	0.16	0.00	0.02	3.55	0.03	57.45	0.36	0.02	1.17	31.05	1.71	0.60

b.d. - below detection

* - mean and standard deviation calculated from 70 recent analyses of TCA-8010, by ICP-AES after an Aqua Regia digestion.

TCA-8010
ICP-AES analyses with the silt and clay-sized fraction

TCA 8010

Element	Sc	Sr	Ti	Tl	U	V	W	Zn
Unit	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm
Detection limit	1	1	0.01	10	10	1	10	2
December 19, 1996								
'96-PMA-021-1 -2u'	4	18	0.06	5	5	27	5	32
'96-PMA-088-1 -2u'	5	23	0.08	5	5	28	5	28
'96-PMA-139-1-63u'	6	23	0.09	5	5	30	5	30
'96-PMA-171-1-63u'	5	24	0.08	5	5	27	5	30
December 19, 1996								
'96-PMA-231-1-63u'	6	24	0.09	5	5	30	5	30
'96-PMA-251-1-63u'	6	26	0.08	5	5	31	5	30
October 28, 1997								
97PL0044	5	22	0.08	5	5	29	5	28
97PL0049	5	22	0.08	5	5	29	5	26
97PL0054	4	14	0.05	5	5	23	5	24
97PL0059	5	24	0.08	5	5	26	5	28
January 13, 1999								
98PL 0450	4	19	0.07	5	5	24	5	26
98PL 0454	5	22	0.07	5	5	25	5	28

mean*	4.57	20.61	0.07	b.d.	b.d.	25.35	b.d.	27.48
stddev	0.56	3.61	0.01	0.00	0.00	3.02	0.00	6.37

b.d. - below detection

* - mean and standard deviation calculated from 70 recent analyses of TCA-8010, by ICP-AES after an Aqua Regia digestion.

TCA-8010
INA analyses

TCA 8010

Element	Au	As	Ba	Br	Ca	Co	Cr	Cs	Fe	Hf	Hg	Ir	Mo	Na	Ni	Rb	Sb	Sc	Se	Sn	Sr	Ta	Th
Unit	ppb	ppm	ppm	ppm	%	ppm	ppm	ppm	%	ppm	ppm	ppb	ppm	%	ppm	ppm	ppm	ppm	ppm	%	%	ppm	ppm
Detection limit	2	0.5	50	0.5	1	1	5	1	0.01	1	1	5	1	0.01	20	15	0.1	0.1	5	0.01	0.05	0.5	0.2
December 11, 1996																							
96-PMA 021-1	148	5.1	540	0.25	0.5	8	46	1	2.14	6	0.5	2.5	0.5	2.07	10	54	2	10	2.5	0.005	0.025	0.25	4.9
96-PMA 088-1	193	7	640	0.25	0.5	9	52	0.5	2.32	8	0.5	2.5	0.5	2.29	10	84	2.5	10	2.5	0.005	0.025	0.25	6
96-PMA 139-1	141	5	560	0.25	2	7	42	1	2.05	6	0.5	2.5	0.5	1.96	10	58	1.9	8.2	2.5	0.005	0.025	0.25	4.4
96-PMA 171-1	150	5.1	510	2.4	0.5	6	44	2	1.75	6	0.5	2.5	0.5	1.88	10	42	2	7.6	2.5	0.005	0.025	0.25	4.5
96-PMA 230-1	138	5.3	430	0.25	1	7	45	0.5	1.92	6	0.5	2.5	0.5	1.89	10	59	2.1	7.8	2.5	0.005	0.025	0.25	4.9
96-PMA 251-1	170	6.2	520	2.4	2	7	52	1	2.17	8	0.5	2.5	0.5	2.03	10	53	2.4	8.9	2.5	0.005	0.025	1	5.8
November 21, 1997																							
97PL0063	158	4.5	430	1.9	1	8	54	0.5	2.01	8	0.5	2.5	0.5	2.34	10	64	7.1	9.5	2.5	0.005	0.025	0.25	5.1
97PL0067	148	5.3	470	1.9	2	8	53	2	2.16	8	0.5	2.5	2	2.27	10	51	2.4	9.9	2.5	0.005	0.025	0.25	4.8
97PL0071	144	5.6	420	1.9	2	8	53	2	2.22	8	0.5	2.5	0.5	2.19	10	55	2.4	10.0	2.5	0.005	0.025	0.25	4.5
97PL0075	148	5.4	450	1.8	2	8	51	1	2.19	8	0.5	2.5	2	2.21	10	52	2.4	9.8	2.5	0.005	0.025	0.25	4.6
97PL0079	146	5.1	480	1.8	2	8	50	1	2.12	7	0.5	2.5	0.5	2.33	10	62	2.5	9.4	2.5	0.005	0.025	0.25	4.7
January 5, 1999																							
"98 PL 455"	155	6.5	530	2.5	1	9	50	1	2.05	7	0.5	2.5	0.5	2.01	10	52	2.4	10.1	2.5	0.005	0.025	0.6	4.9
"98 PL 460"	136	6.3	450	2.1	2	8	50	1	2.1	6	0.5	2.5	3	2	10	57	2.4	10	2.5	0.005	0.025	0.7	4.7
"98 PL 466"	140	7	440	2.2	1	8	47	1	2	6	0.5	2.5	0.5	2.02	10	52	2.5	10	2.5	0.005	0.025	0.6	4.7
mean*	165.65	6.76	616.50	2.51	1.61	9.35	58.15	1.33	2.41	8.55	b.d.	b.d.	1.25	2.38	b.d.	60.95	2.92	10.94	b.d.	b.d.	b.d.	0.71	5.76
stddev	37.04	1.20	167.21	0.61	0.61	1.60	11.46	0.77	0.43	1.85	0.00	0.00	1.91	0.35	0.00	14.63	0.74	1.89	0.00	0.00	0.06	0.57	1.20

b.d. - below detection

* - mean and standard deviation calculated from 20 recent analyses of TCA-8010 by INA at Activation Laboratories.

TCA-8010
INA analyses

TCA 8010

Element	U	W	Zn	La	Ce	Nd	Sm	Eu	Tb	Yb	Lu	Mass
Unit	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	g
Detection limit	0.5	1	50	0.50	3.00	5.00	0.1	0.2	0.5	0.2	0.05	0.00
December 11, 1996												
96-PMA 021-1	1.8	0.5	25	26	36	14	3.1	1.1	0.25	1.5	0.24	32.21
96-PMA 088-1	2.3	0.5	25	28	45	17	3.9	1.2	0.25	1.7	0.33	27.43
96-PMA 139-1	1.3	0.5	25	23	34	14	3	0.9	0.25	1.5	0.28	30.15
96-PMA 171-1	1.1	0.5	25	22	35	15	3	0.8	0.25	1.7	0.26	31.76
96-PMA 230-1	0.25	0.5	25	22	38	17	3.2	1	0.25	1.5	0.17	33.91
96-PMA 251-1	1	0.5	72	25	43	18	3.6	1.1	0.25	2	0.29	29.6
November 21, 1997												
97PL0063	0.9	0.5	25	27	46	17	3.7	1.0	0.25	2.0	0.32	33.520
97PL0067	1.2	0.5	25	27	44	20	3.6	1.1	0.5	2.0	0.32	35.140
97PL0071	1.1	0.5	25	26	43	20	3.5	1.0	0.7	1.9	0.31	36.240
97PL0075	0.8	0.5	25	26	44	20	3.5	1.0	0.6	1.9	0.31	36.920
97PL0079	1.2	0.5	25	26	44	21	3.4	1.0	0.5	2.0	0.30	37.090
January 5, 1999												
"98 PL 455	"	1.8	0.5	25	21	44	15	3.8	1	0.25	1.4	0.23 35.2
"98 PL 460	"	0.9	0.5	25	22	43	19	3.8	1	0.25	1.5	0.23 37.85
"98 PL 466	"	0.8	0.5	25	23	43	16	3.7	1	0.25	1.5	0.22 34.52

mean*	1.49	b.d.	54.64	27.79	51.35	20.10	4.54	1.22	0.28	2.01	0.30	
stddev	0.54	0.00	35.24	4.70	11.43	4.10	1.07	0.26	0.54	0.36	0.06	

b.d. - below detection

* - mean and standard deviation calculated from 20 recent analyses of TCA-8010 by INA at Activation Laboratories.

Appendix 3
Comparison of commercial
analytical laboratories

